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(54) **INSULATED CONTAINER WITH A DRAWER**

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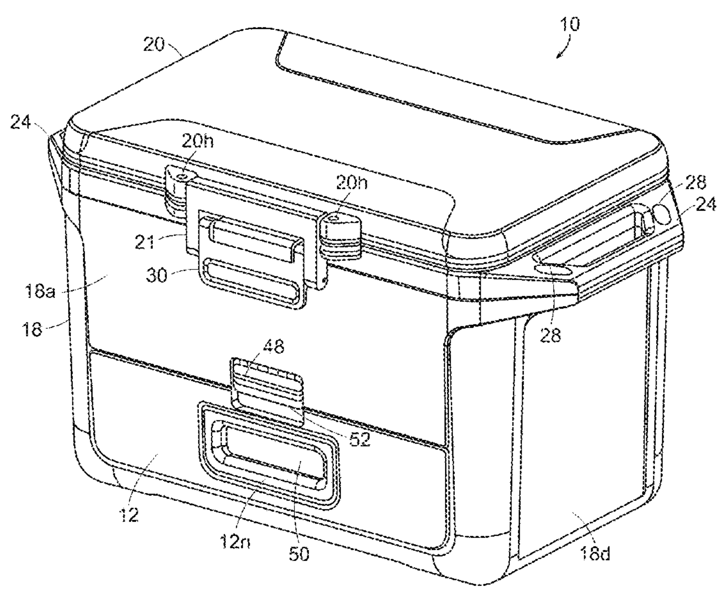
(57) **ABSTRACT**

Various systems, devices, and methods for insulated containers with a drawer are provided. In general, an insulated container, such as a portable cooler, includes a drawer. The insulated container includes a main chamber and includes a drawer chamber that is separate from the main chamber and is configured to movably receive the drawer therein. The main chamber is configured to hold a cooling agent that is configured to cool any items in the main chamber and also any items in the drawer. The insulated container can be manufactured using injection molding.

17 Claims, 45 Drawing Sheets



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U.S. Appl. No. 29/912,295, filed Sep. 15, 2023, Cooler.

* cited by examiner

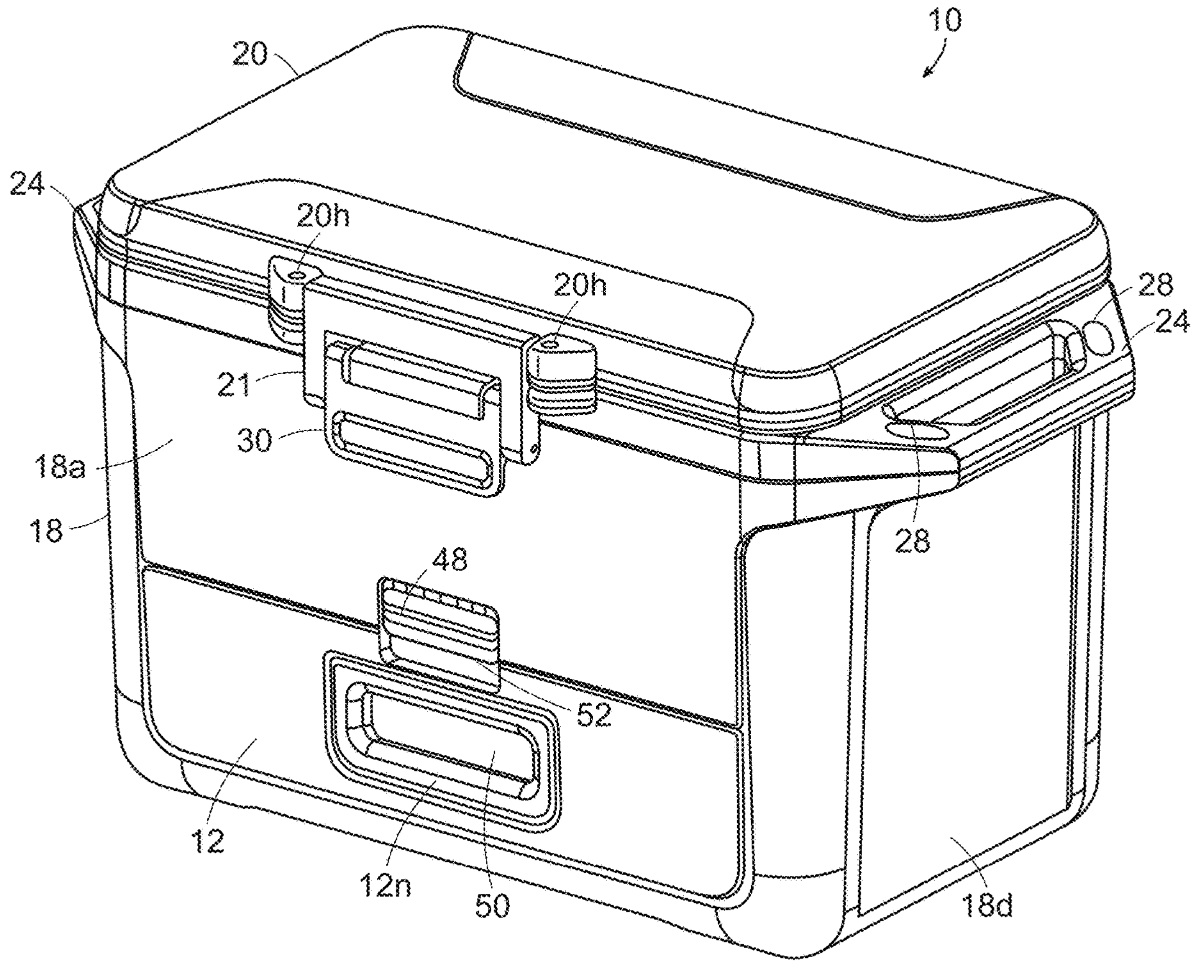


FIG. 1

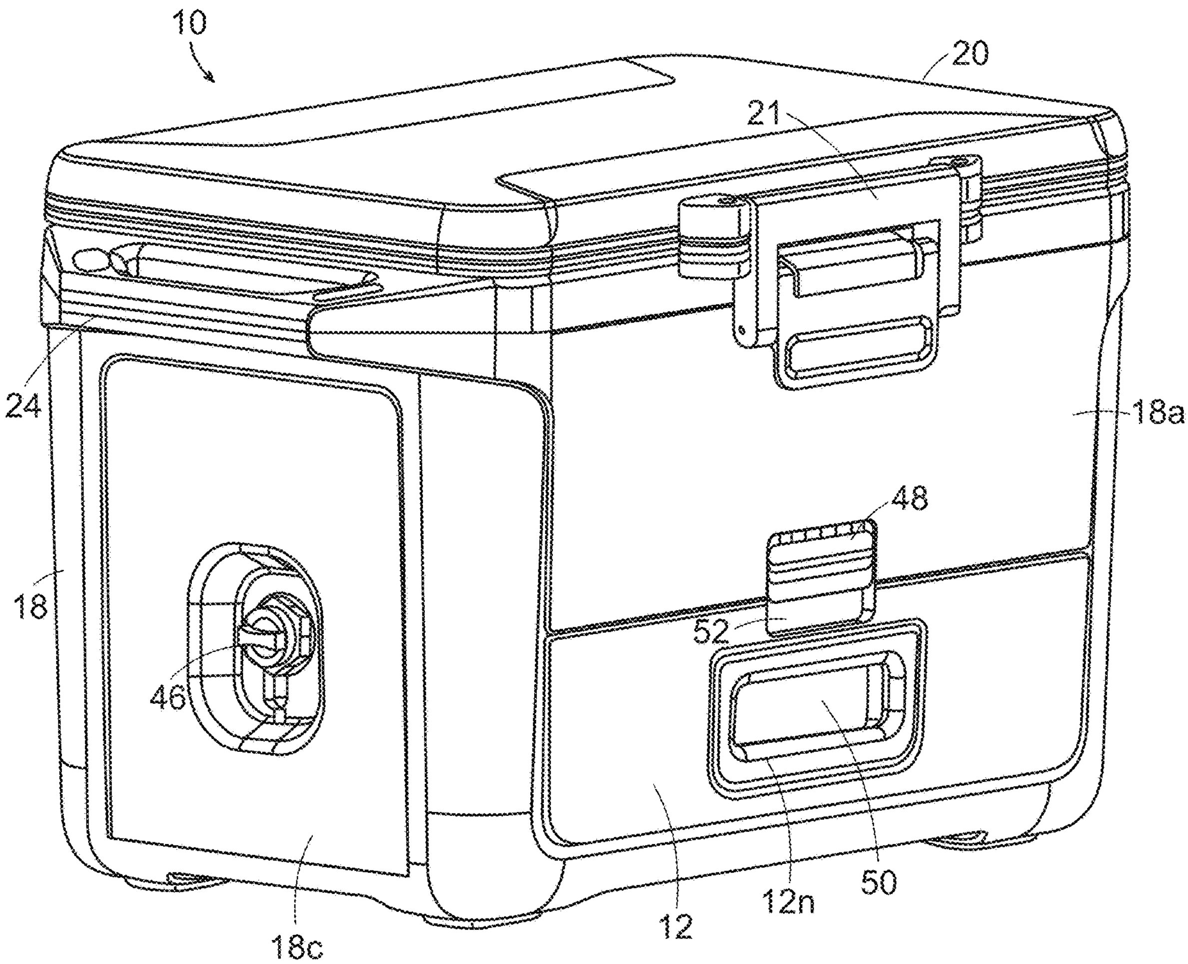


FIG. 2

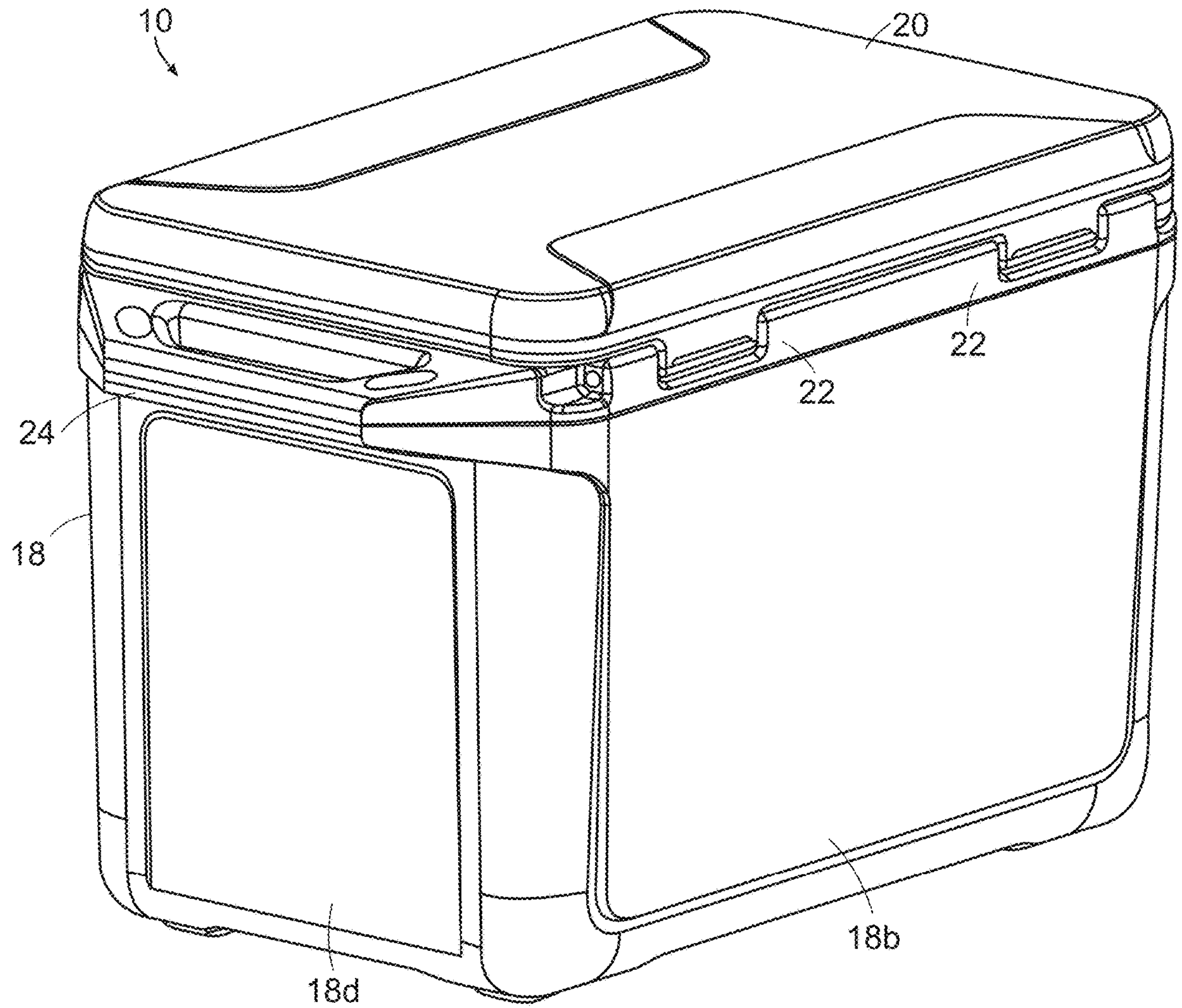
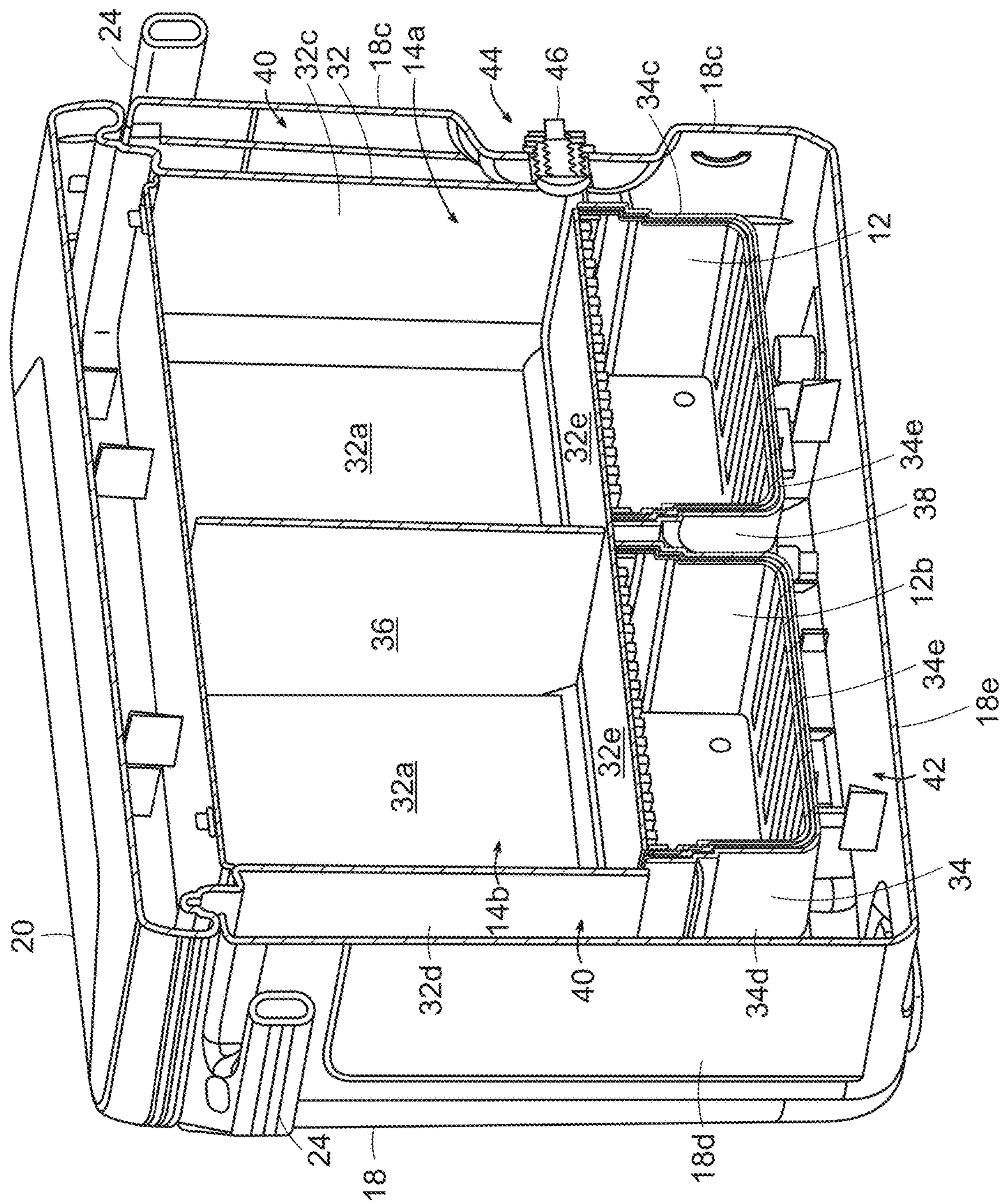


FIG. 3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18c
14a
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46
34c
18c
12
32a
32e
34e
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12b
34e
18e
32a
32e
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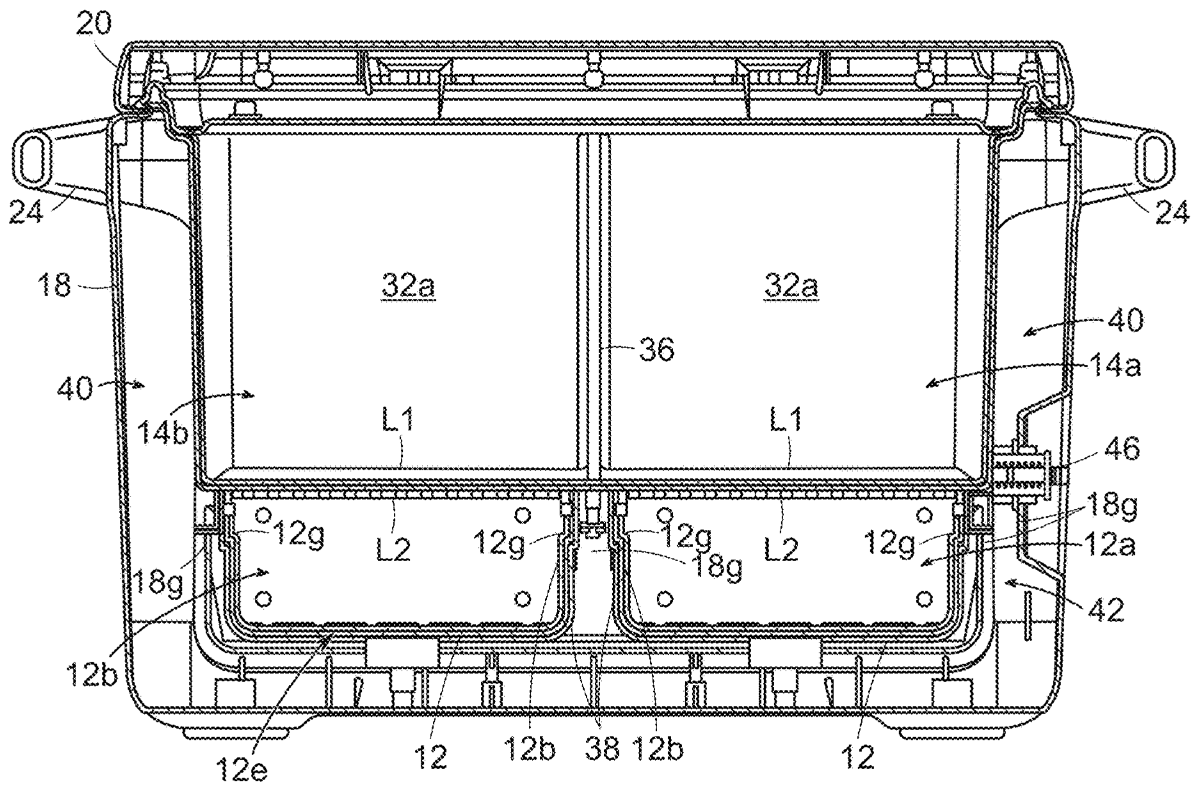
14b
34
20
32d
40
34d
24
18
18d

FIG. 4


20
24
24
18
32a
32a
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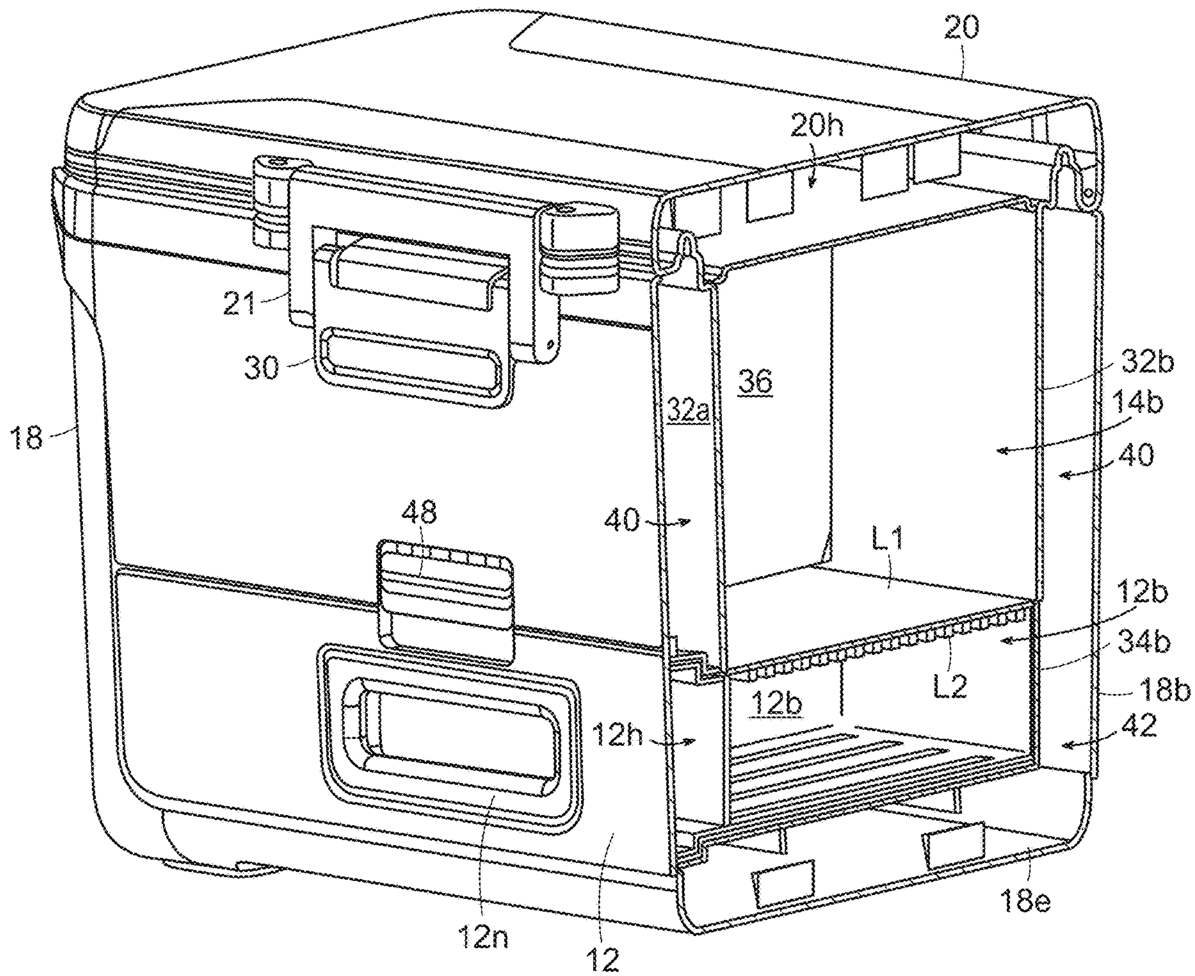
40
40
14a
14b
L1
L1
46
L2
L2
18g
12g
12g
12g
12g
12a
18g
18g
42
12b
12e
12
12b
38
12b
12

FIG. 5


20
20h
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32a
36
32b
14b
40
40
48
L1
12b
34b
12b
L2
18b
12h
42
18e
12n
12

FIG. 6

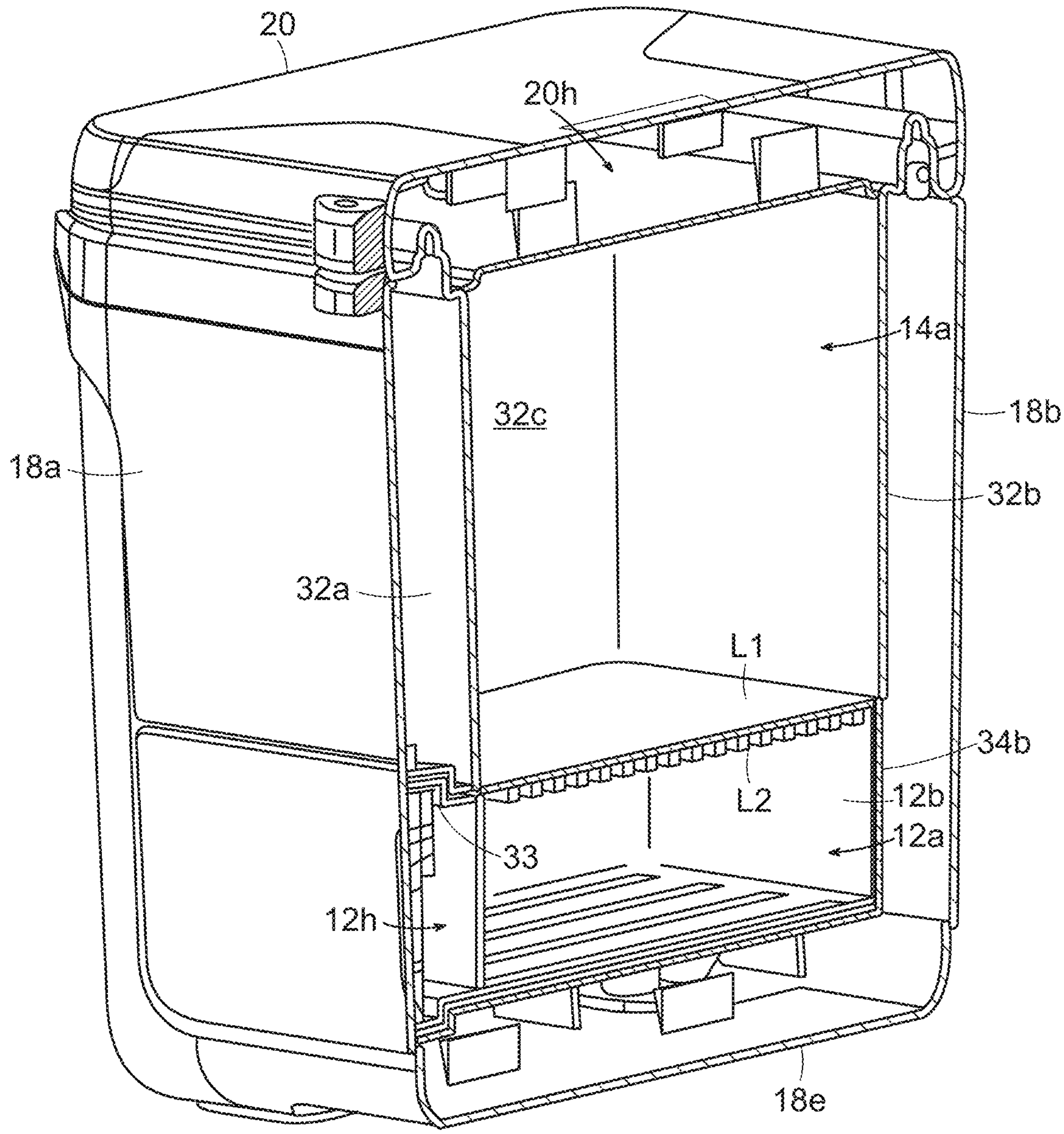


FIG. 7

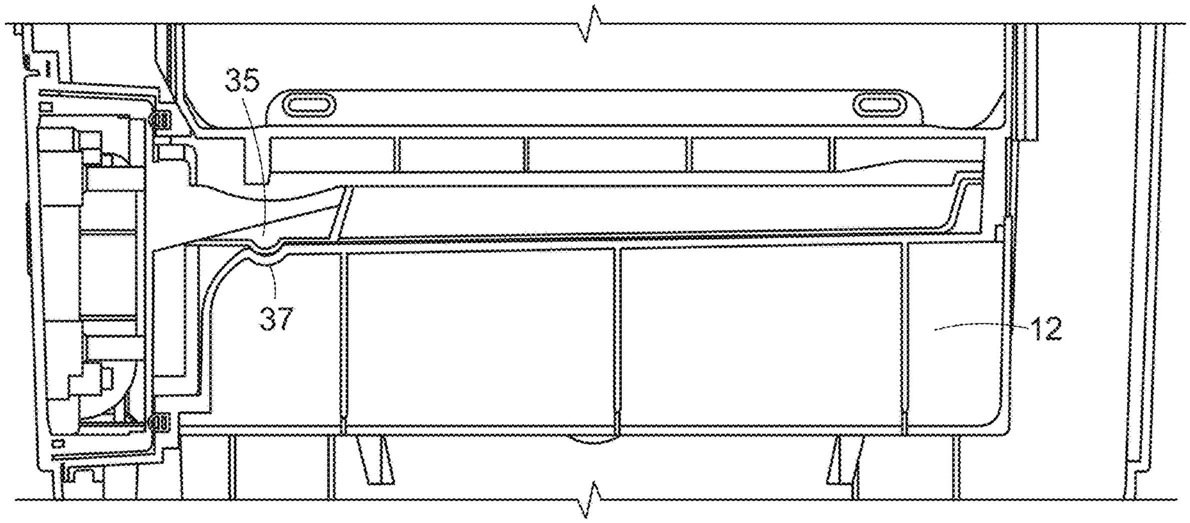


FIG. 7A

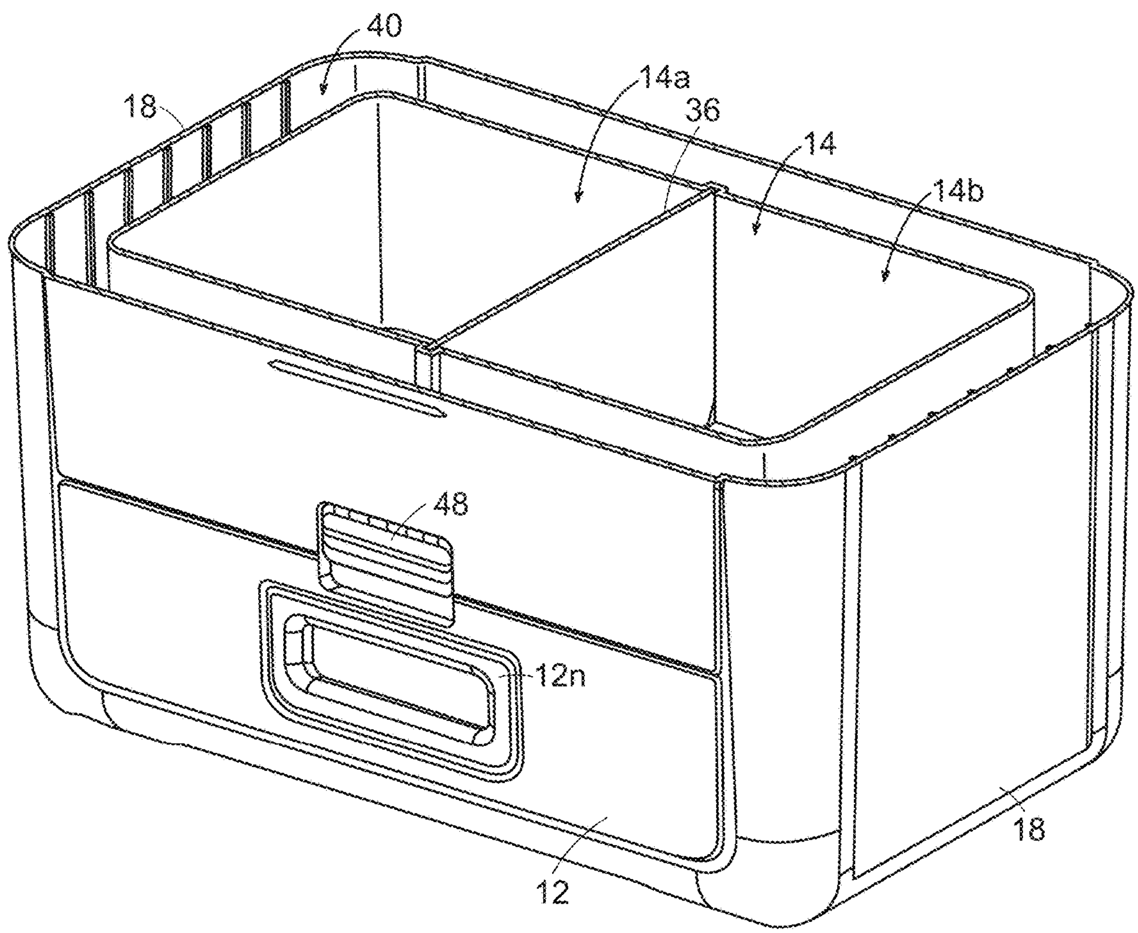


FIG. 8

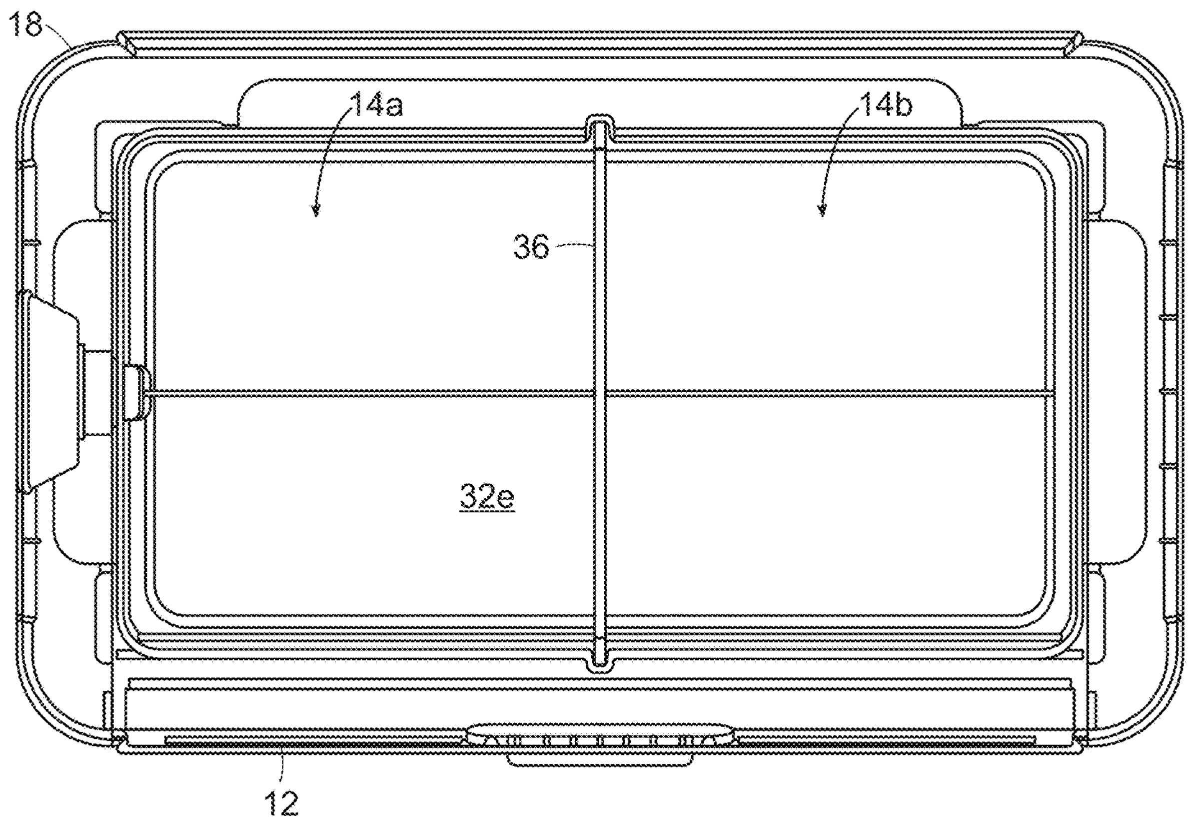


FIG. 9

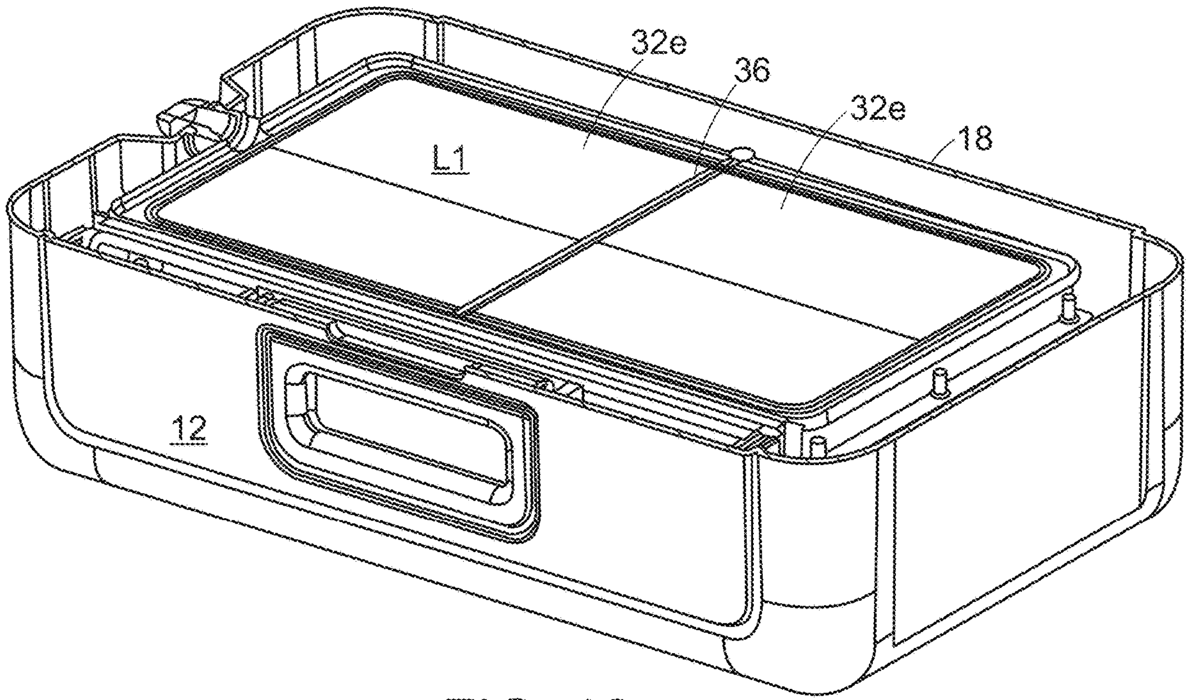


FIG. 10

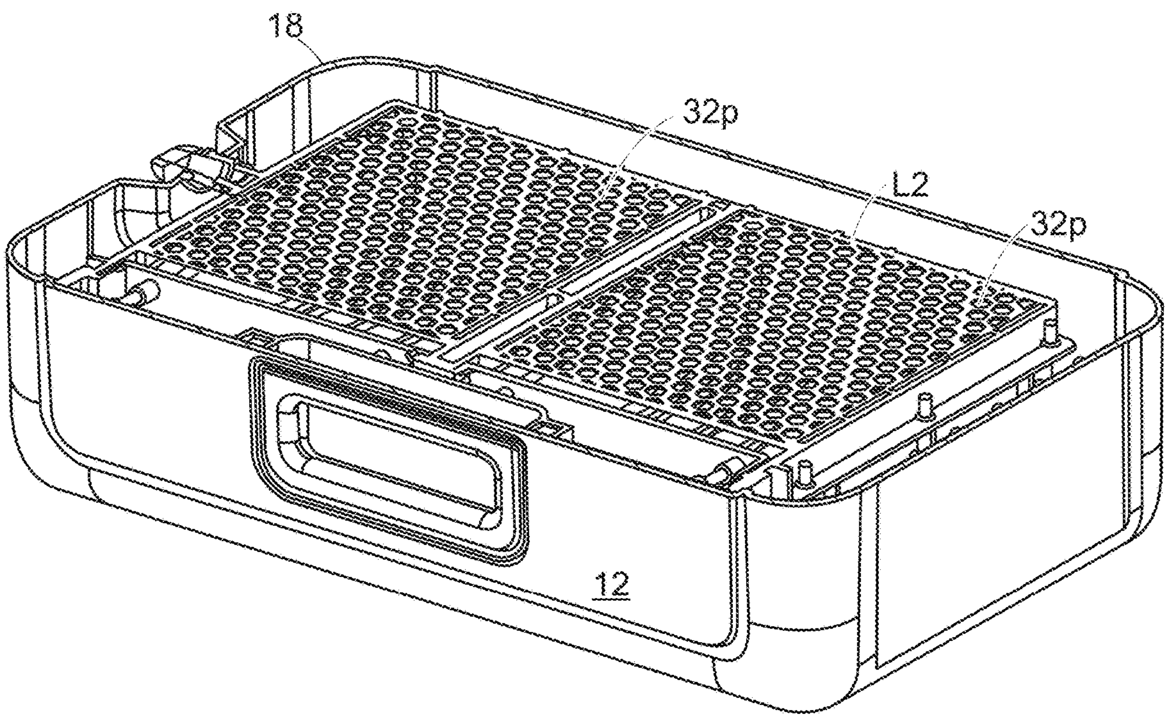


FIG. 11

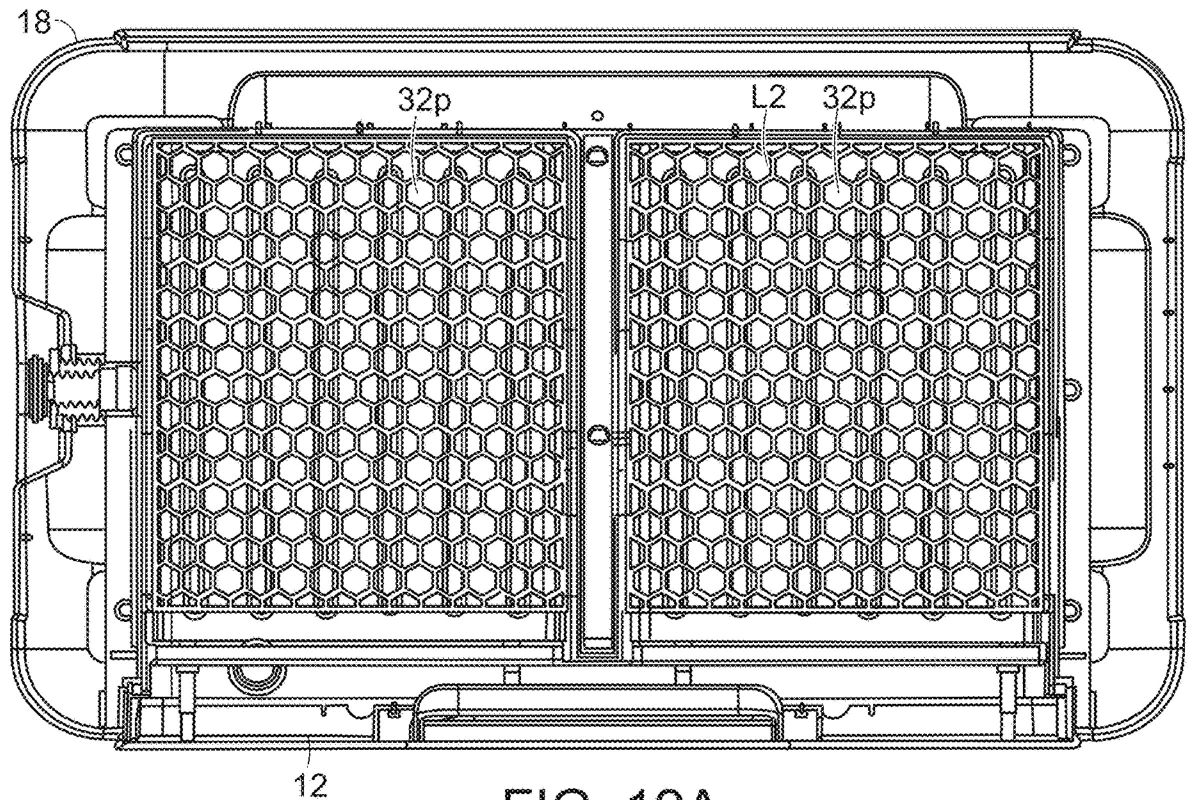


FIG. 12A

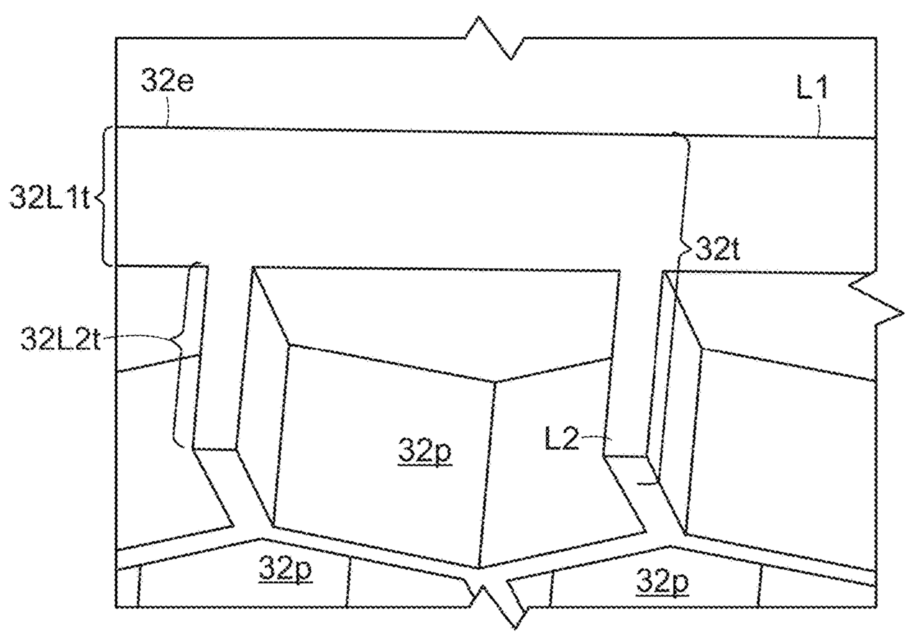


FIG. 12B

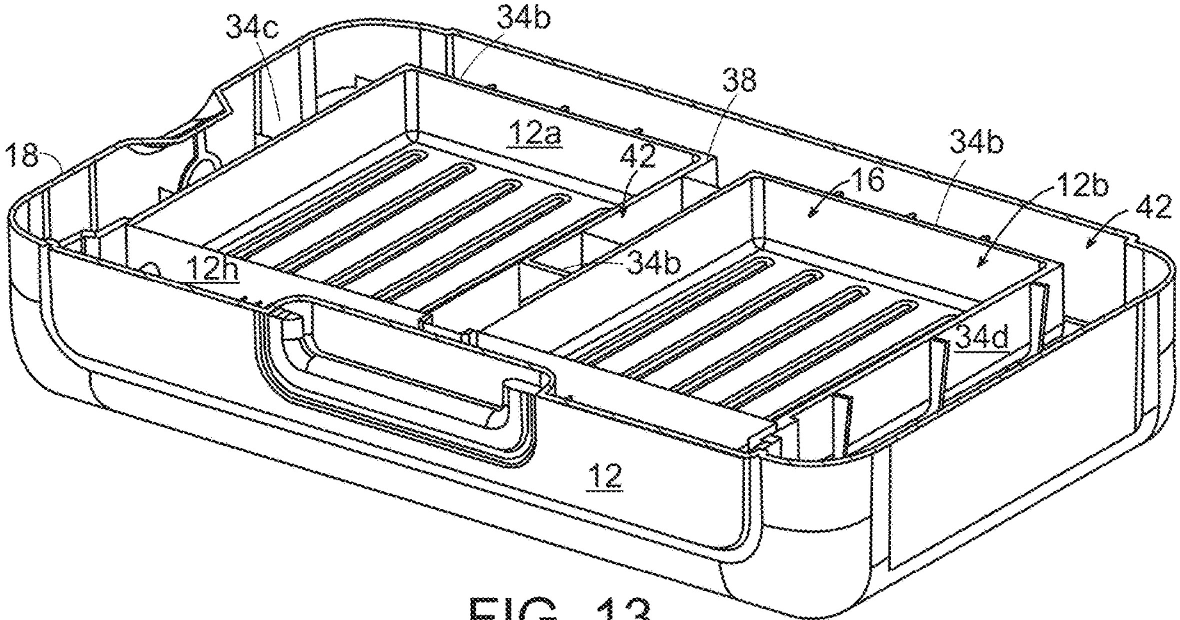


FIG. 13

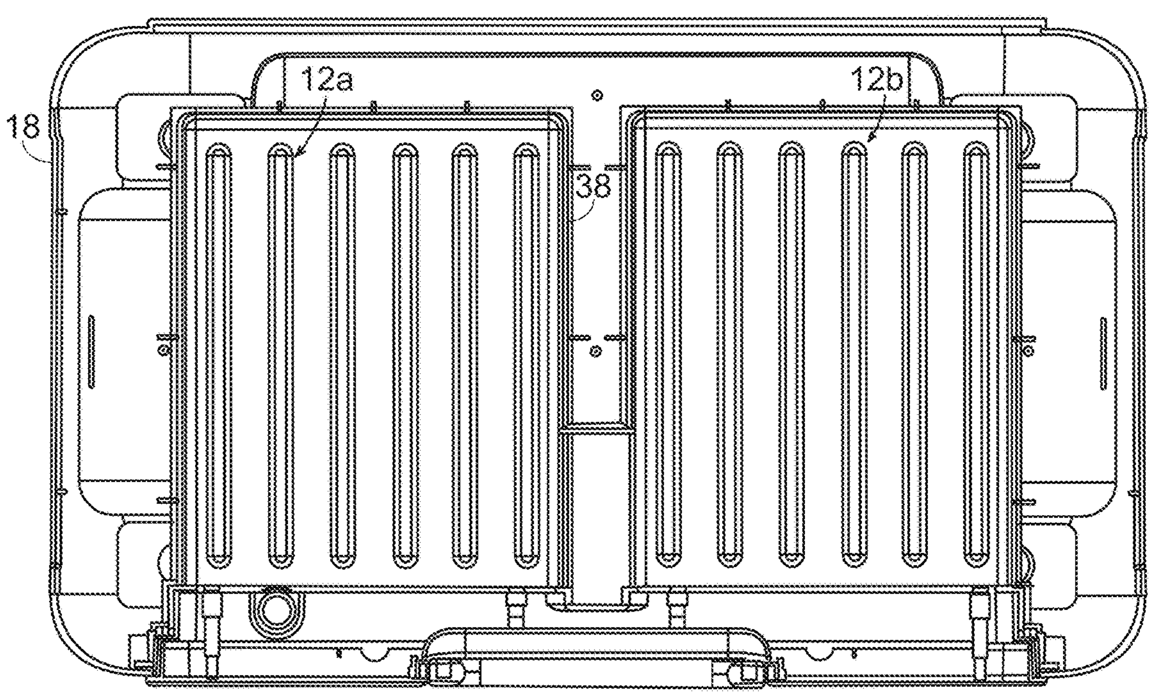


FIG. 14

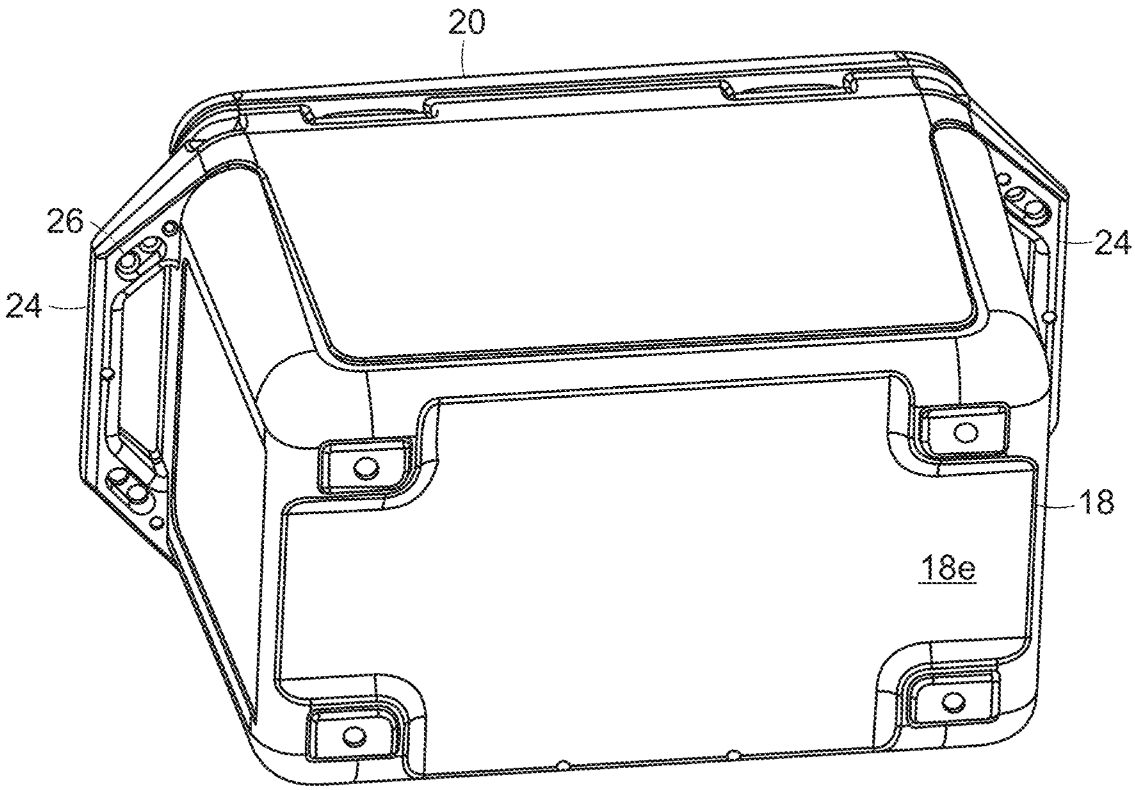


FIG. 15

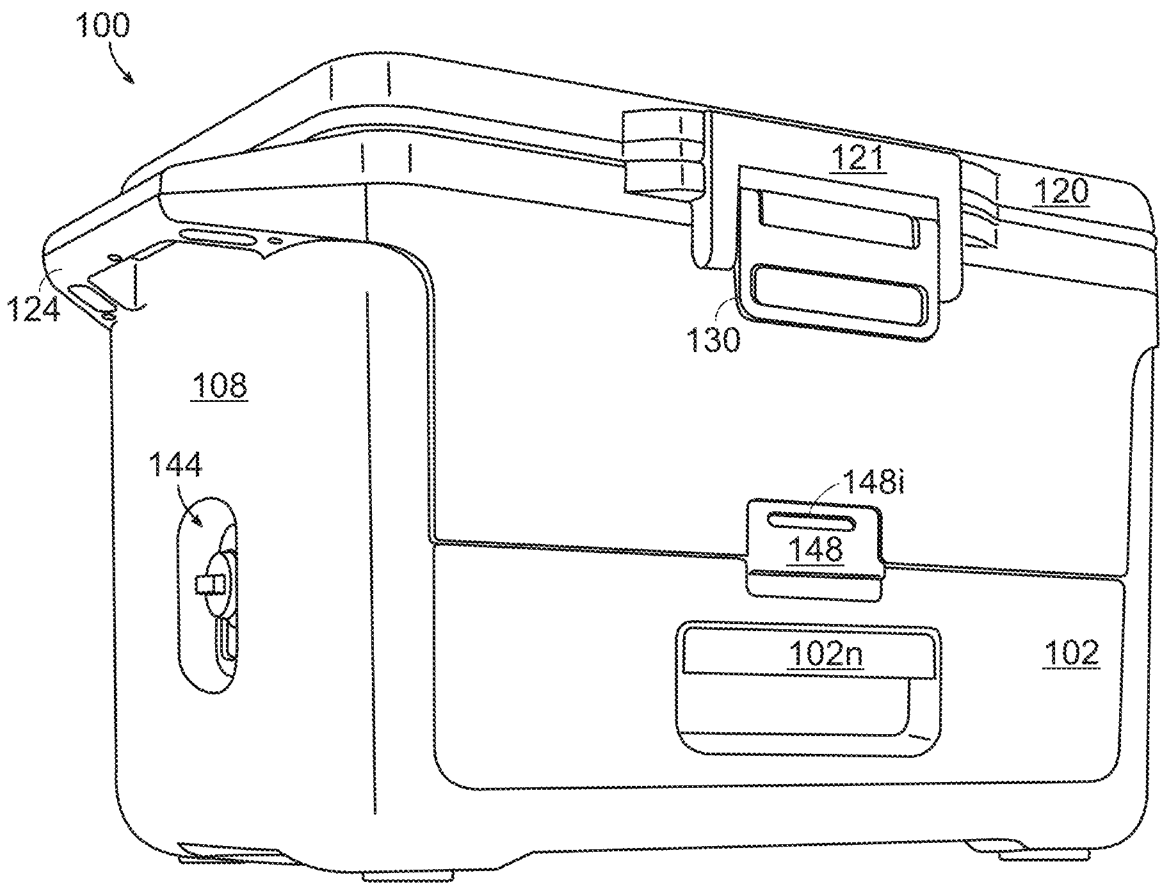


FIG. 16

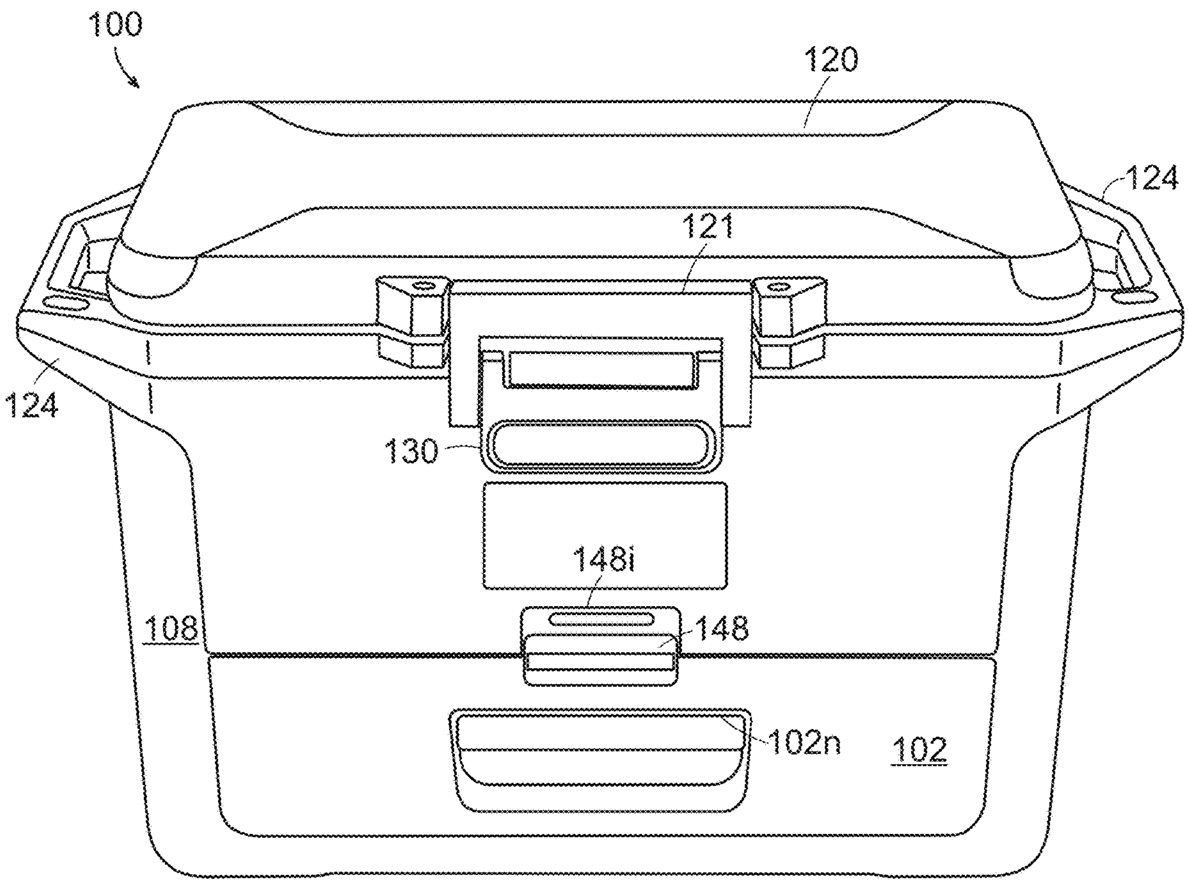


FIG. 17

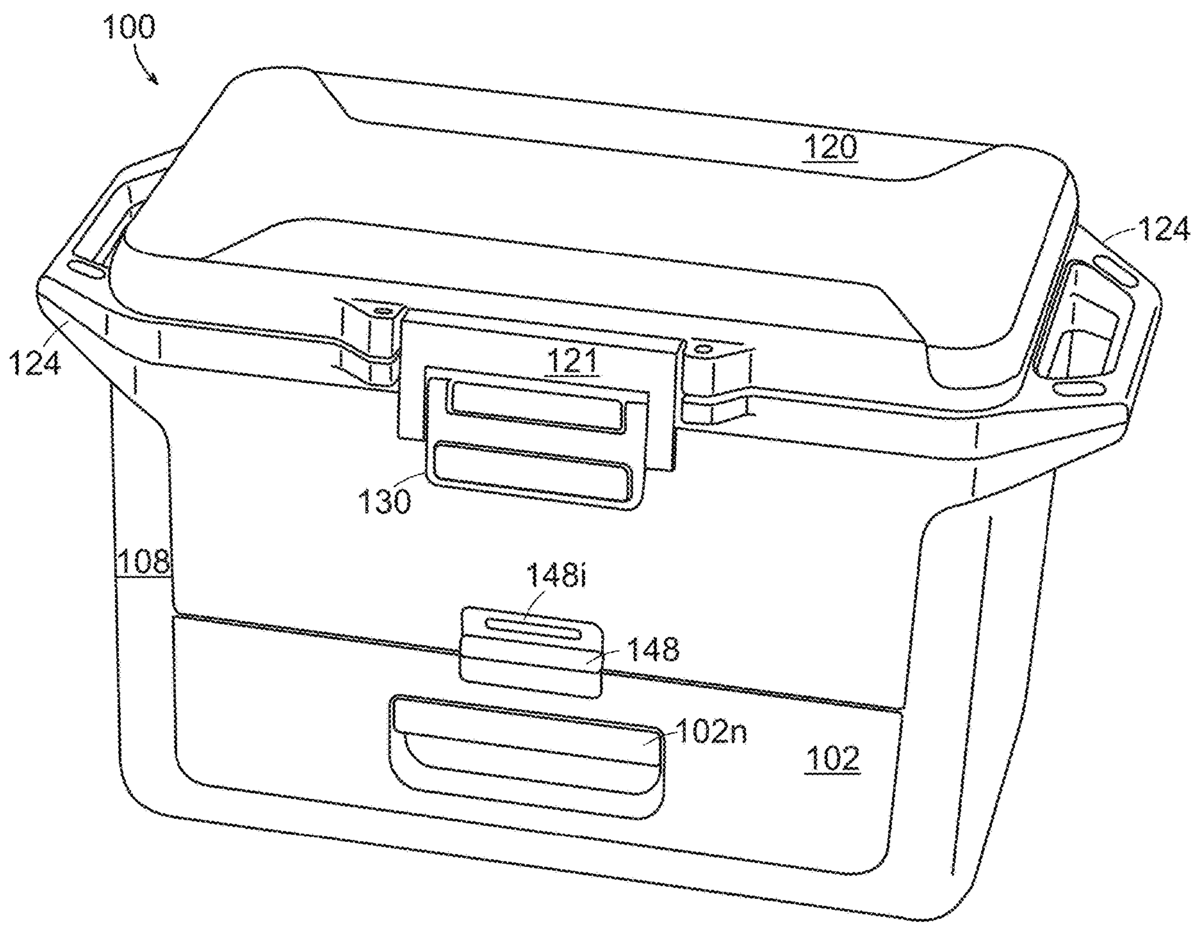
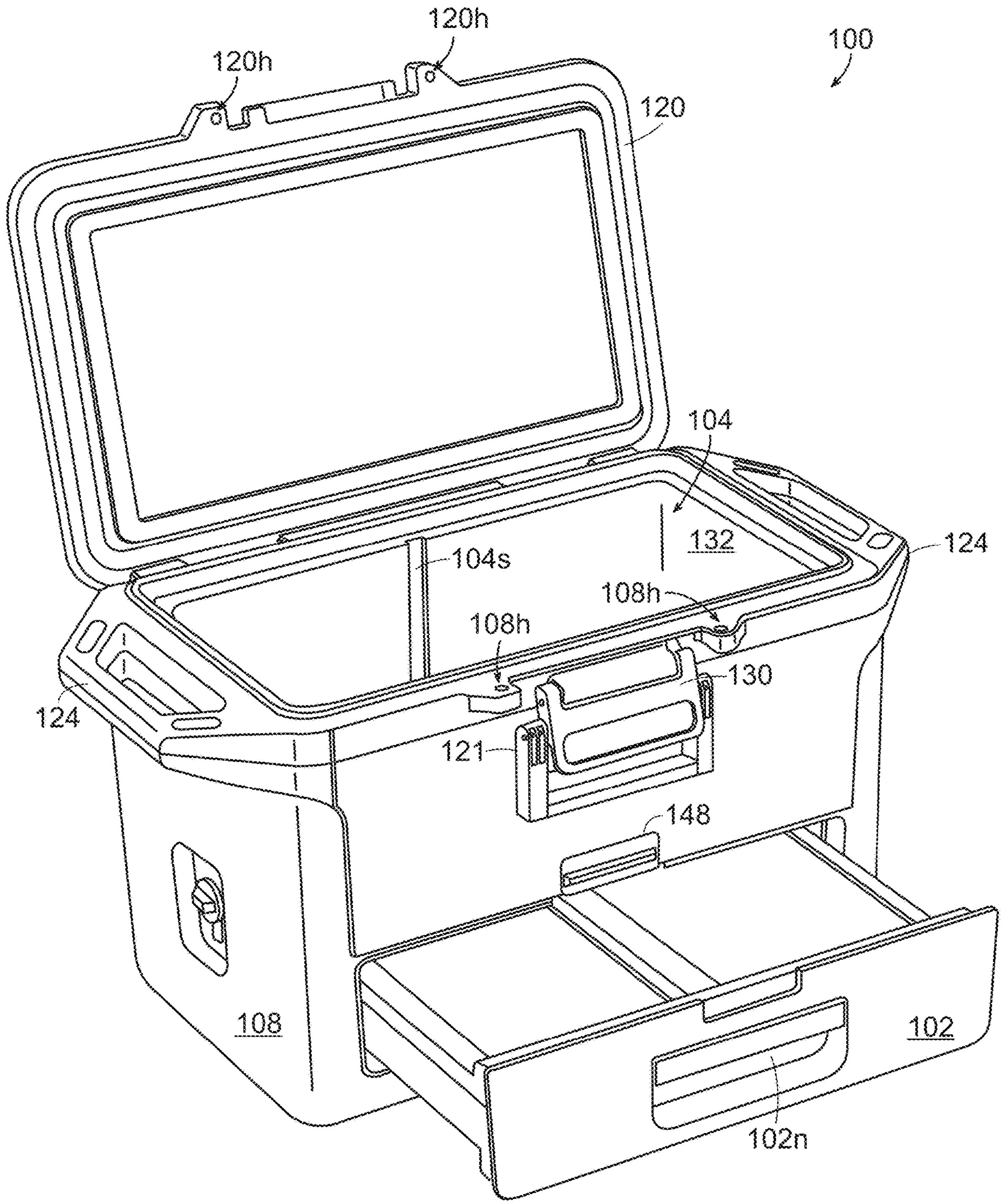


FIG. 18



120h
120h
100
120
104
132
104s
124
108h
108h
130
124
121
148
108
102
102n

FIG. 19

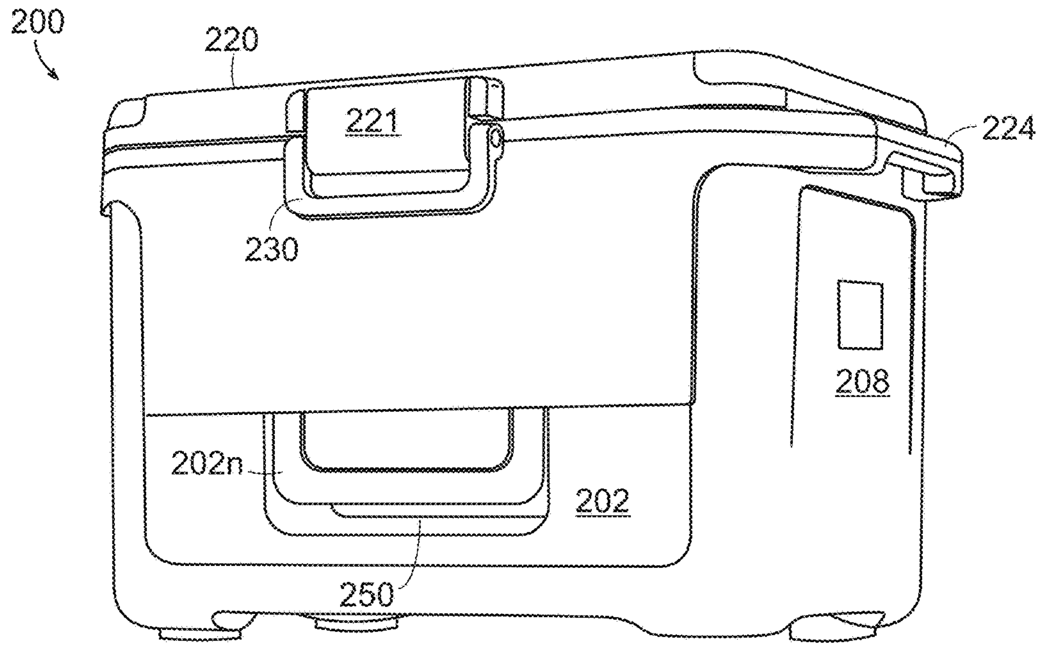
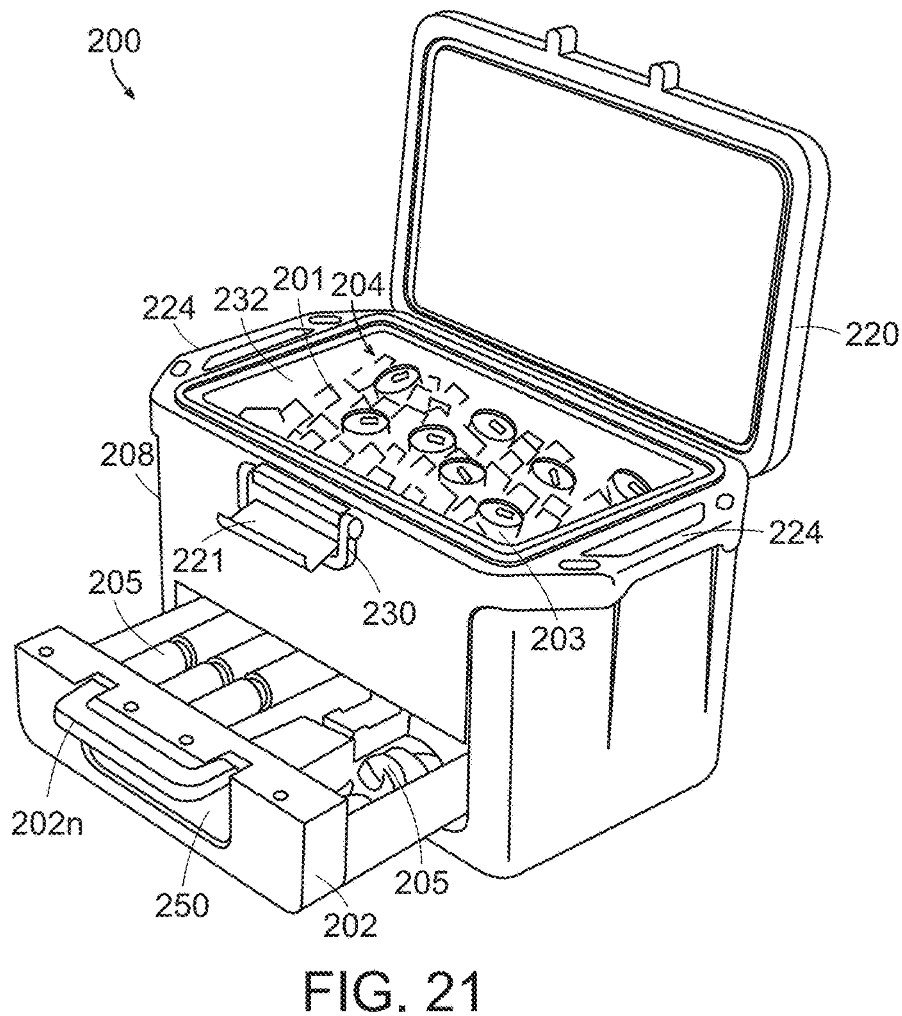

200
220
221
224
230
208
202n
202
250

FIG. 20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202n
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250
202

FIG. 21

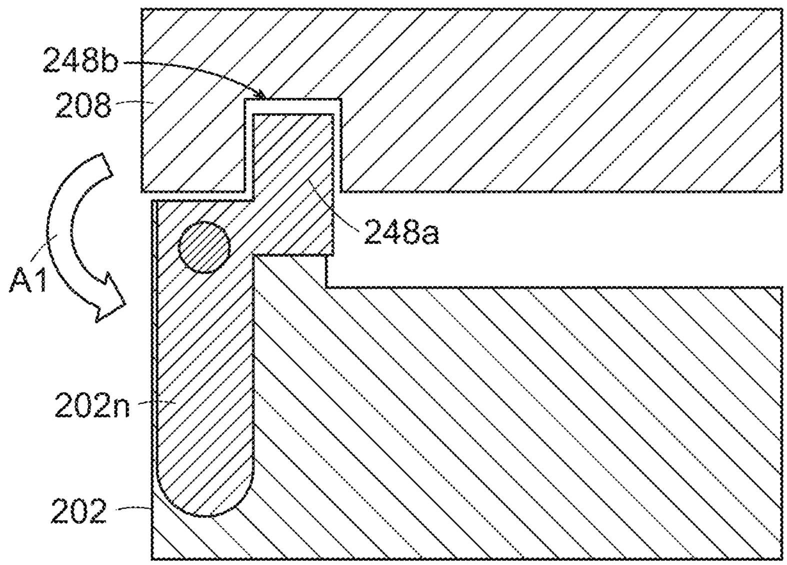

FIG. 22

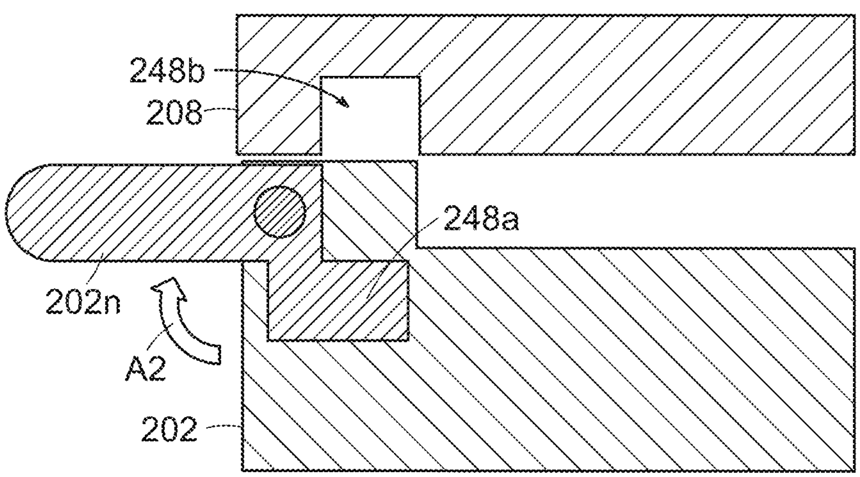

FIG. 23

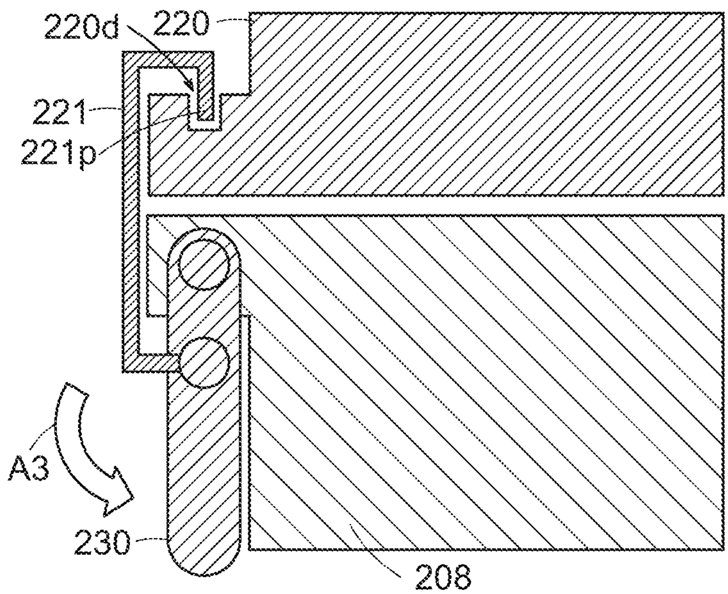

FIG. 24

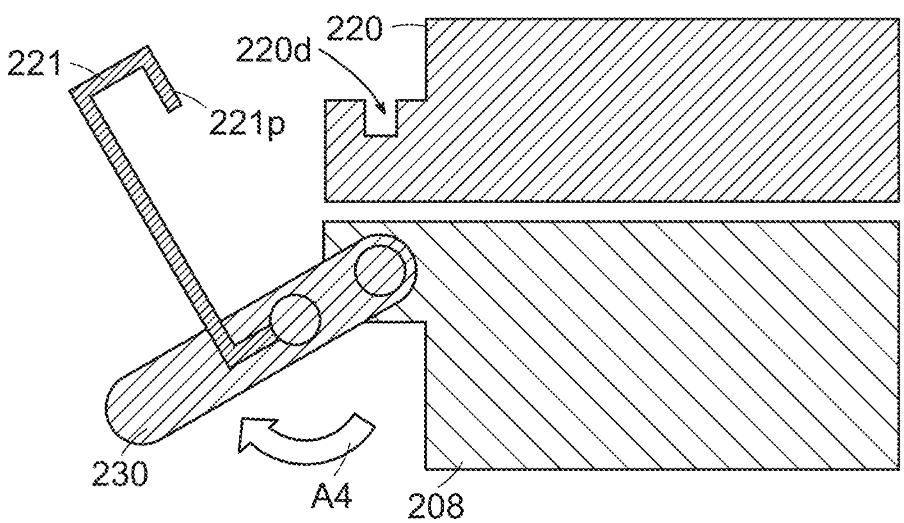

FIG. 25

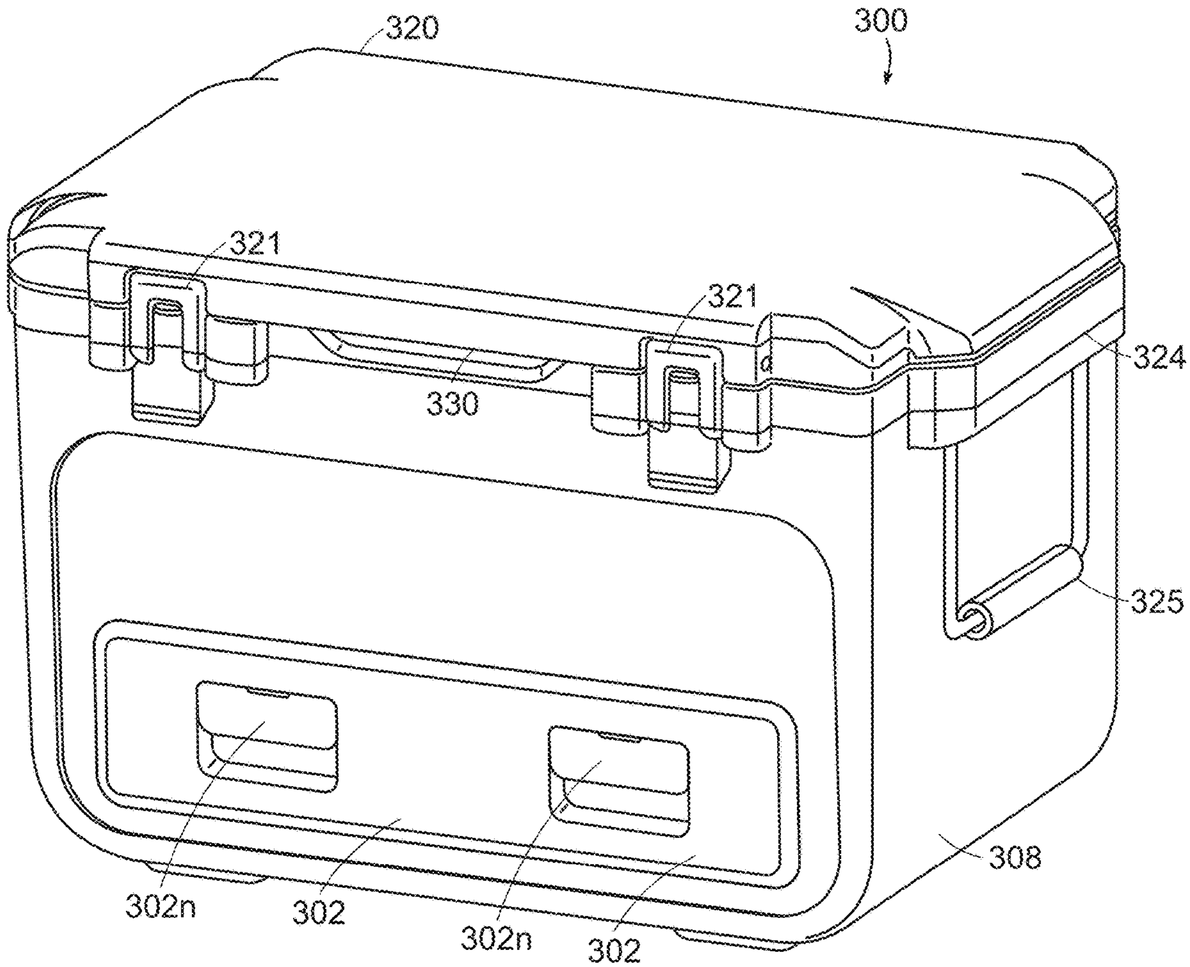

FIG. 26

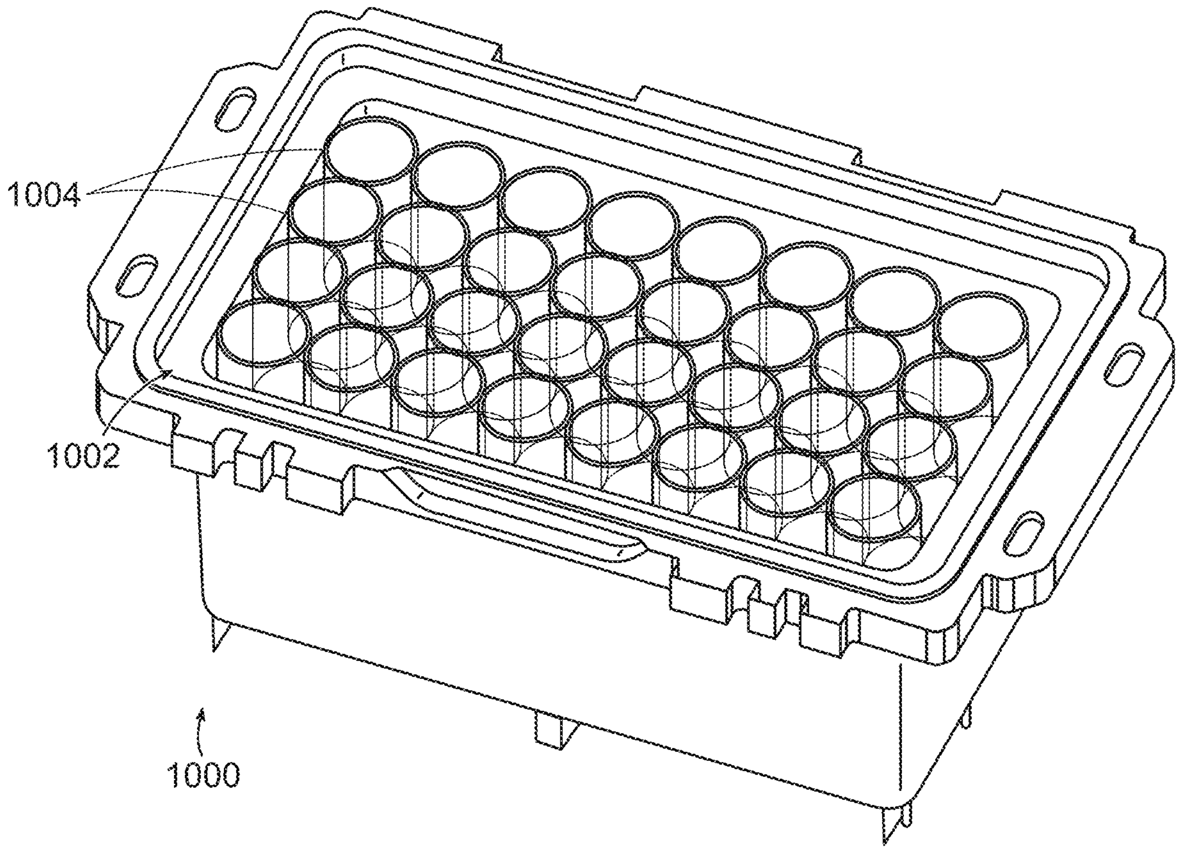

FIG. 27A

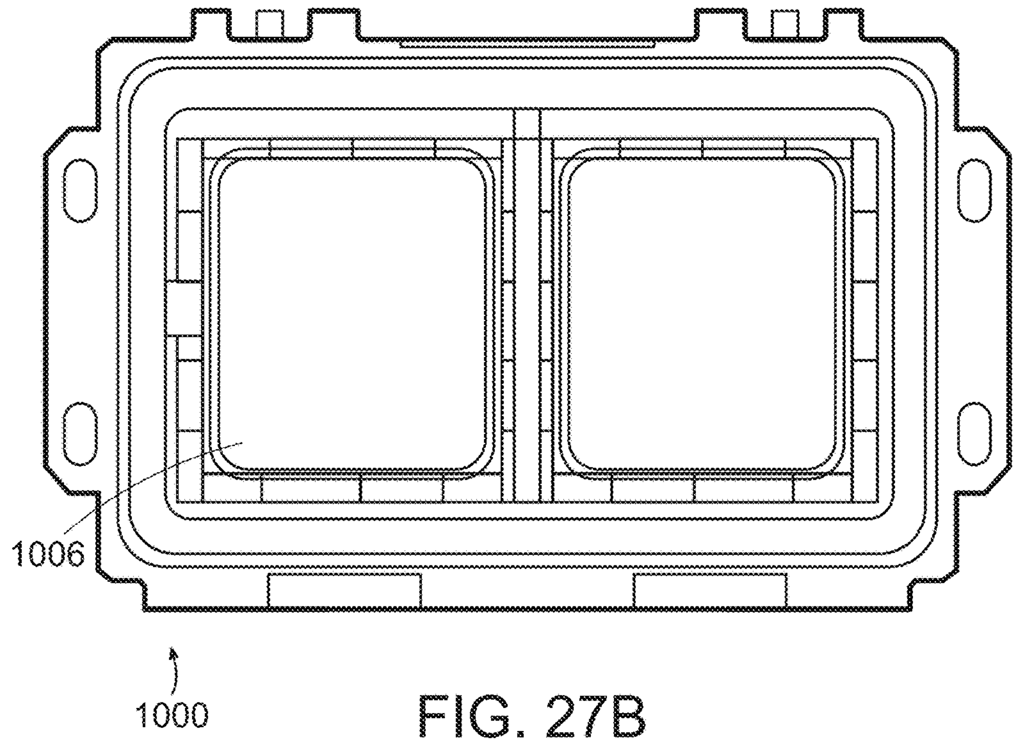

FIG. 27B

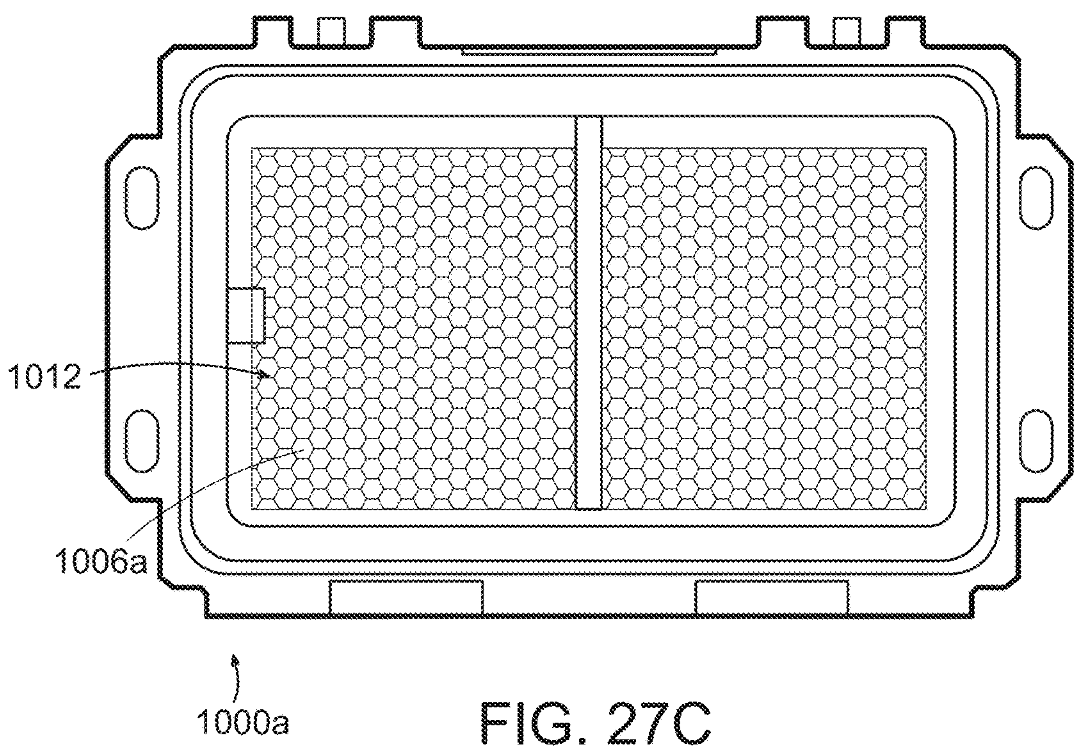

FIG. 27C

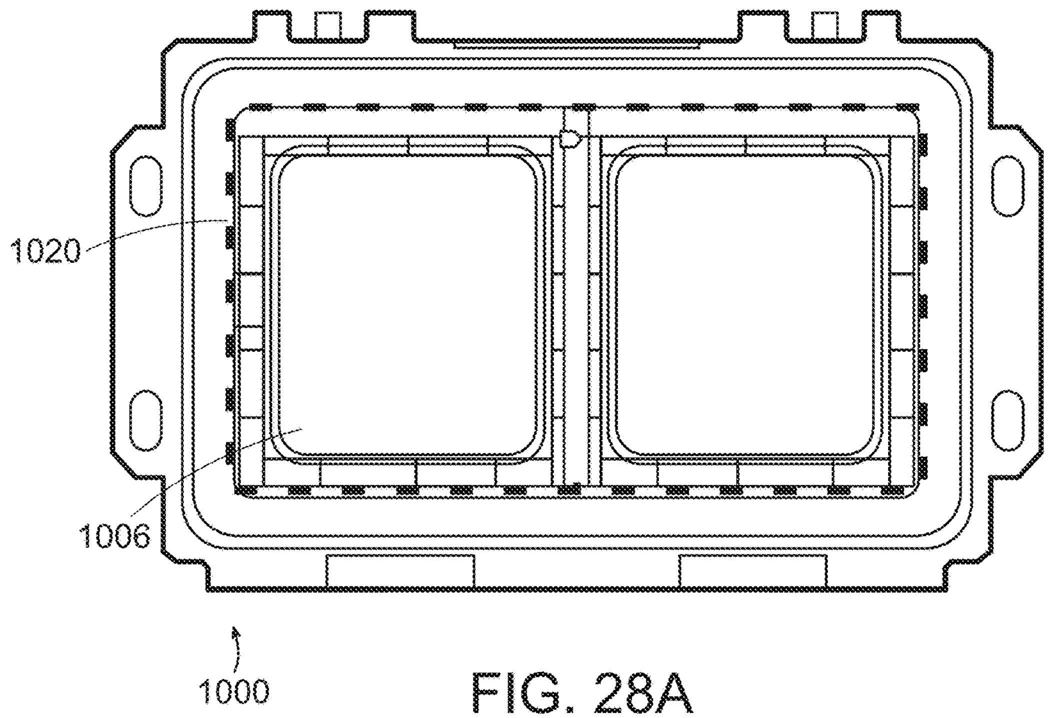

FIG. 28A

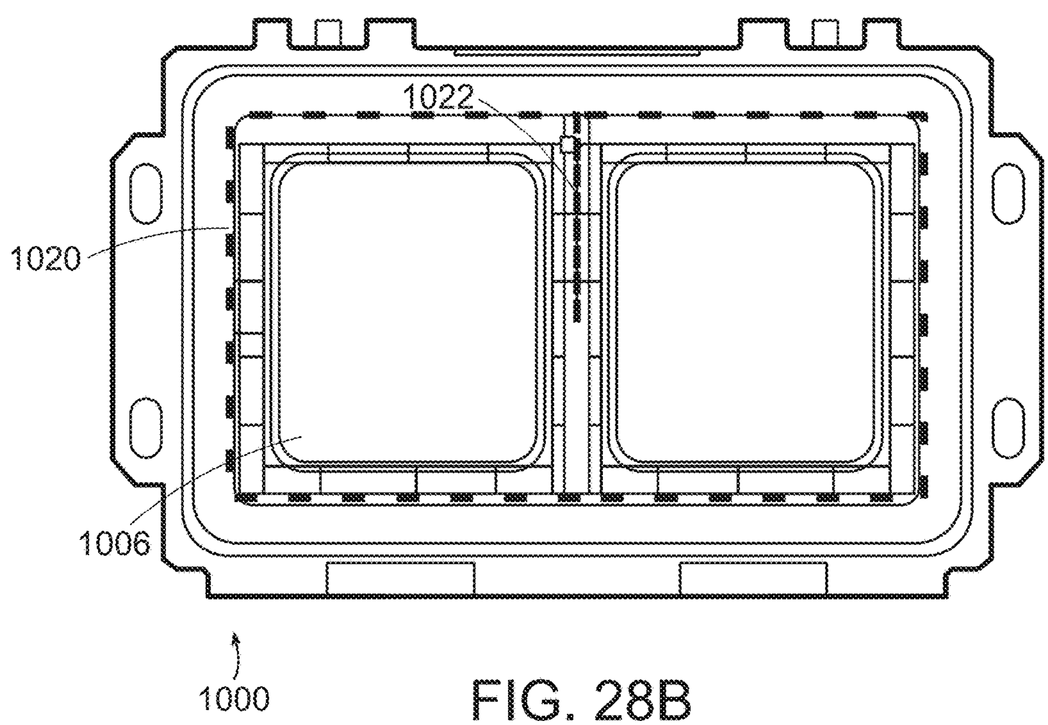

FIG. 28B

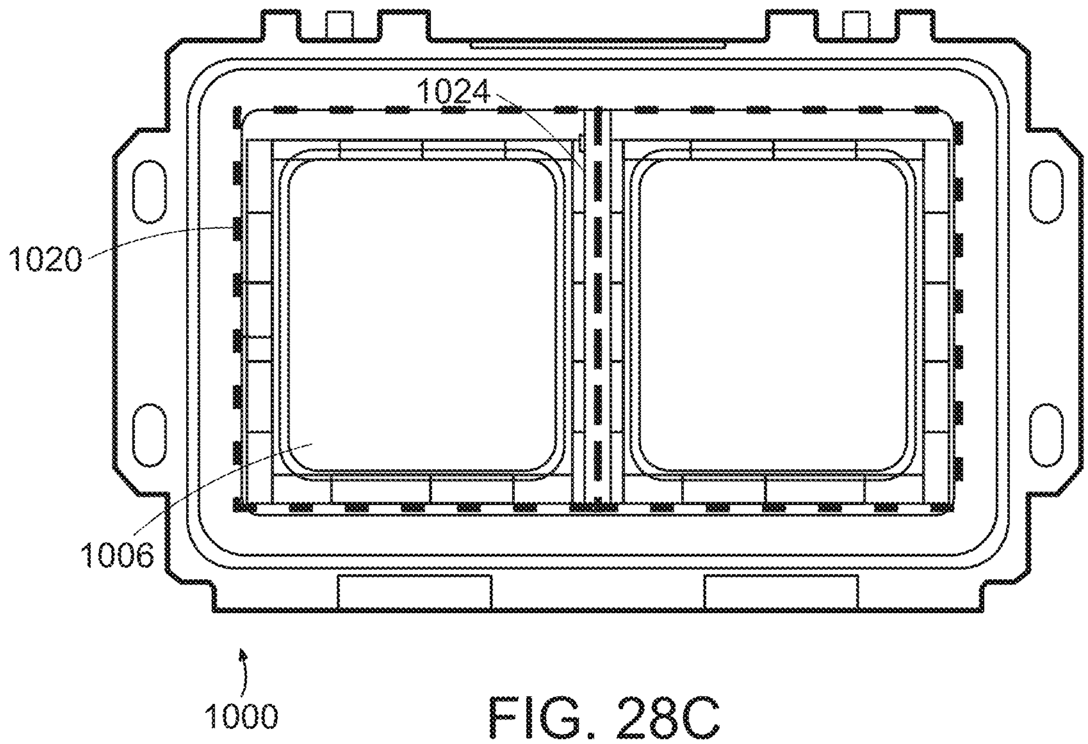

FIG. 28C

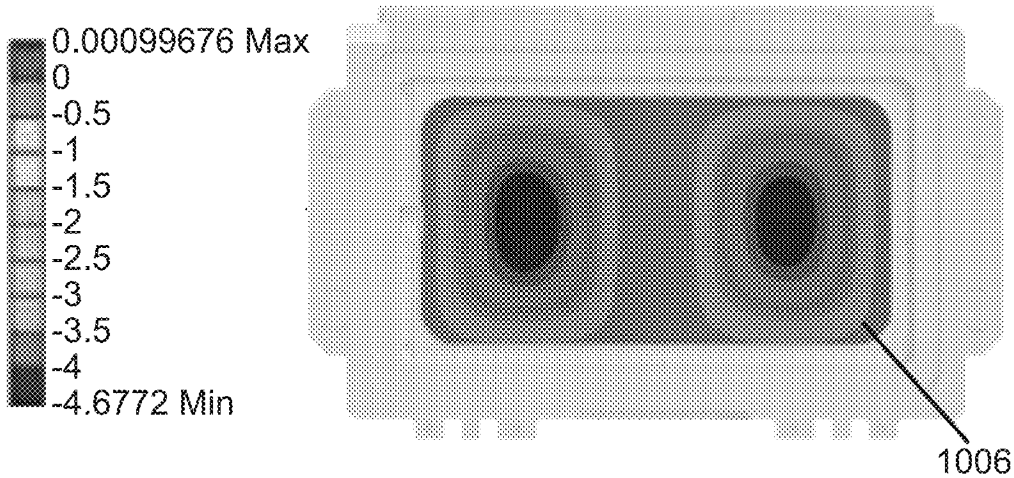

FIG. 29A

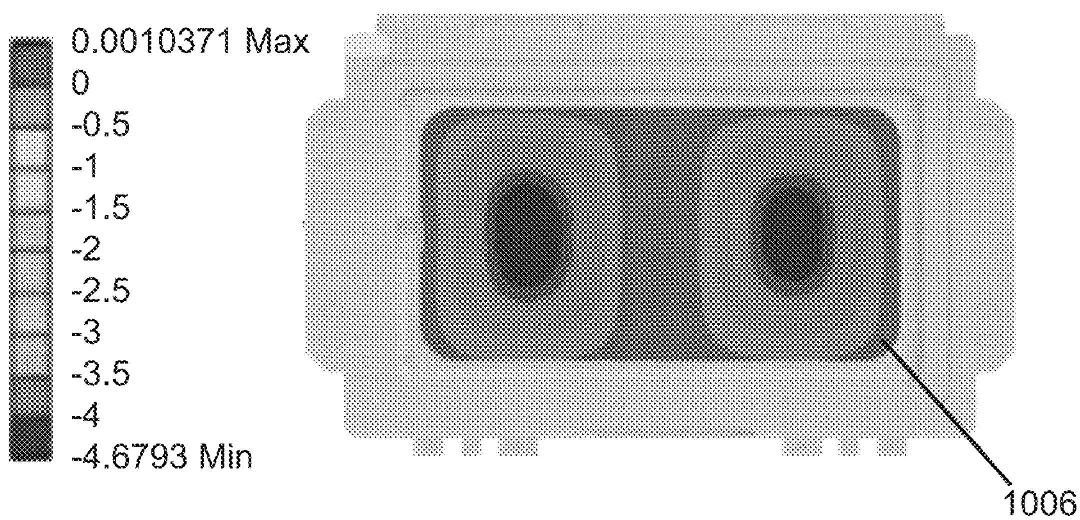

FIG. 29B

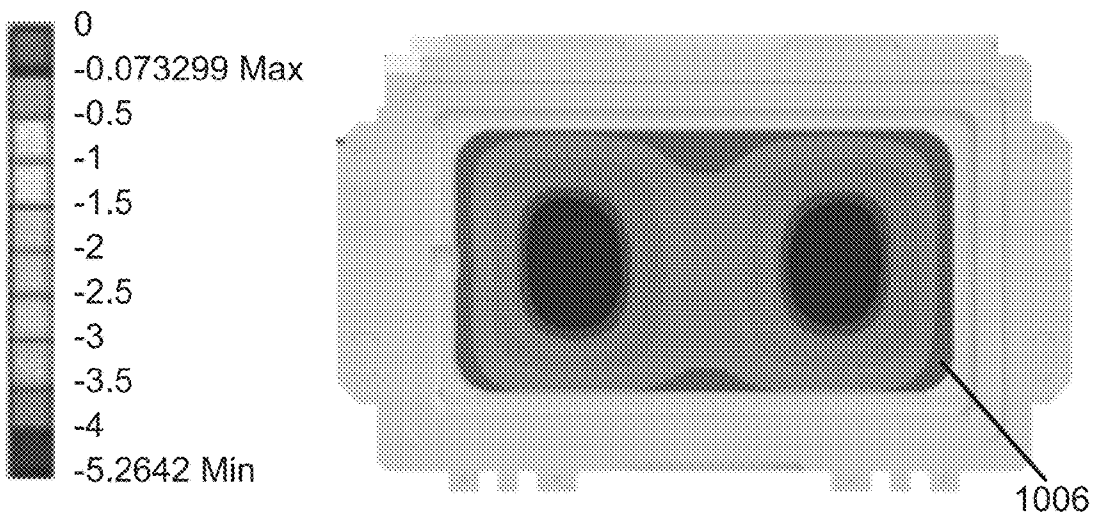

FIG. 29C

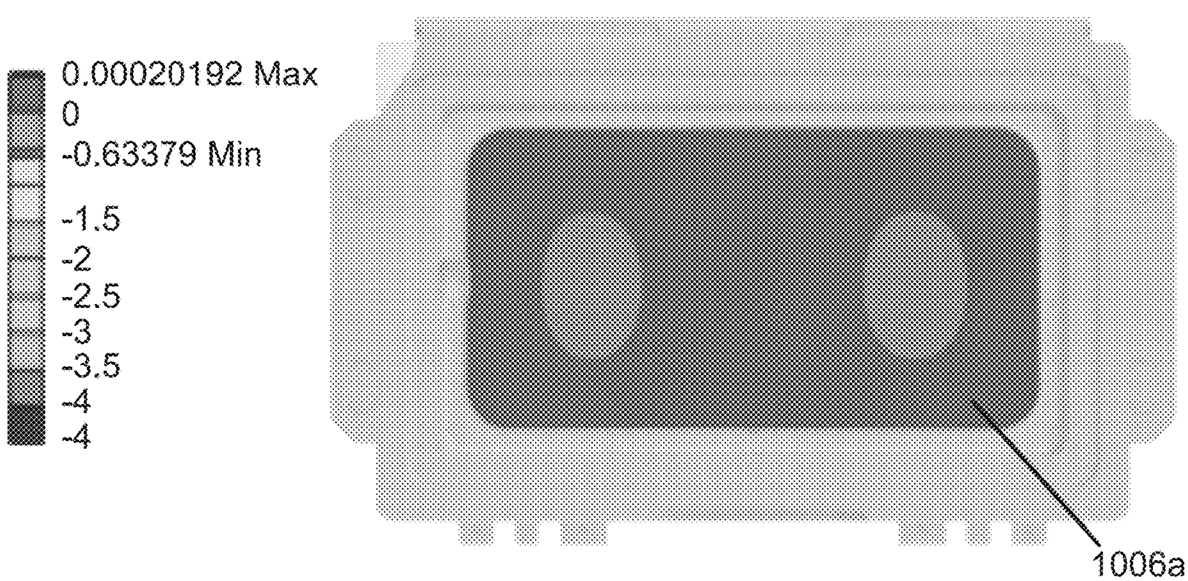

FIG. 30A

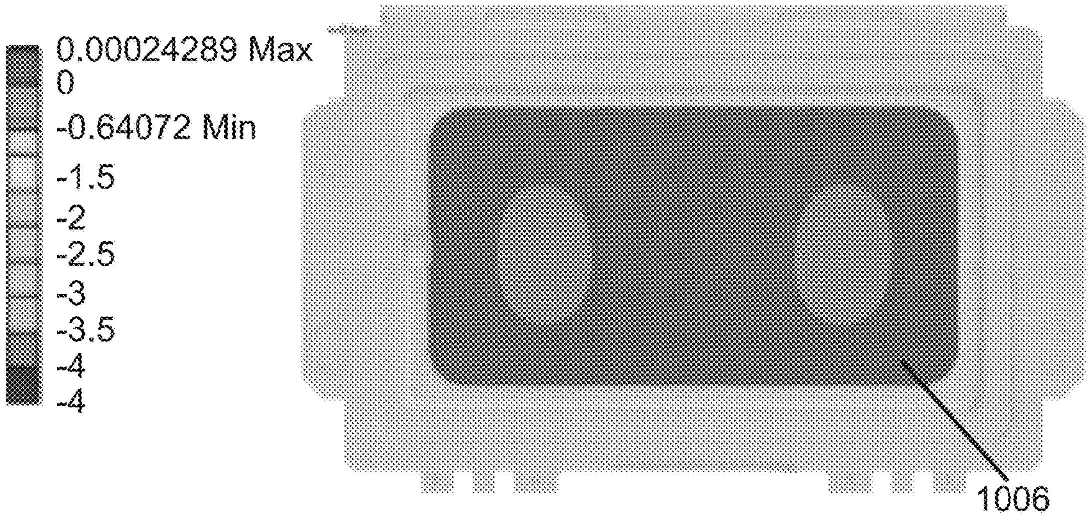

FIG. 30B

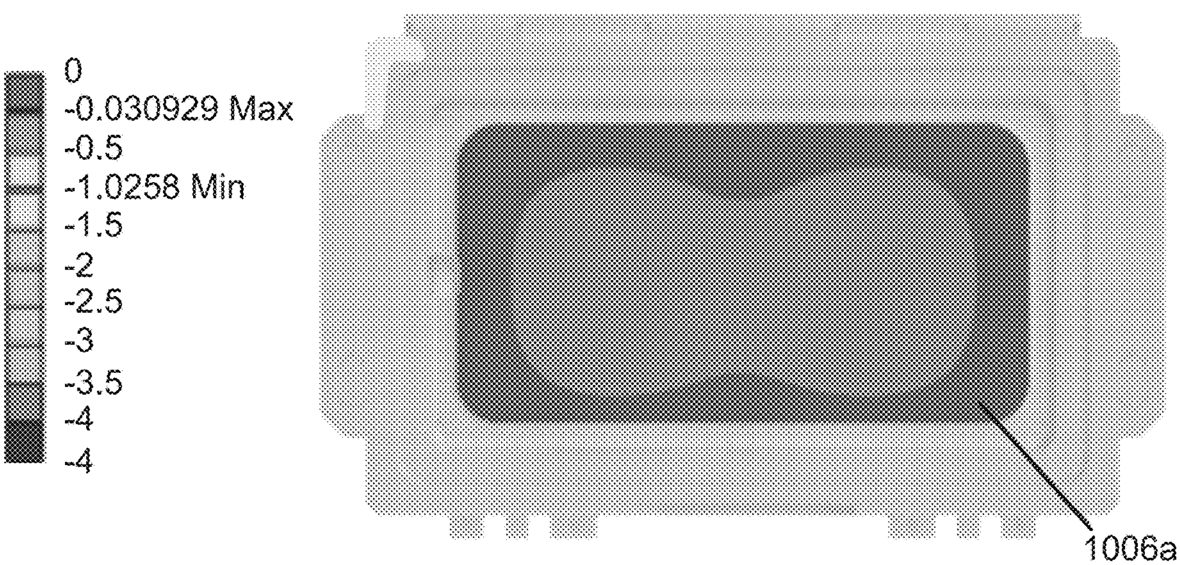

FIG. 30C

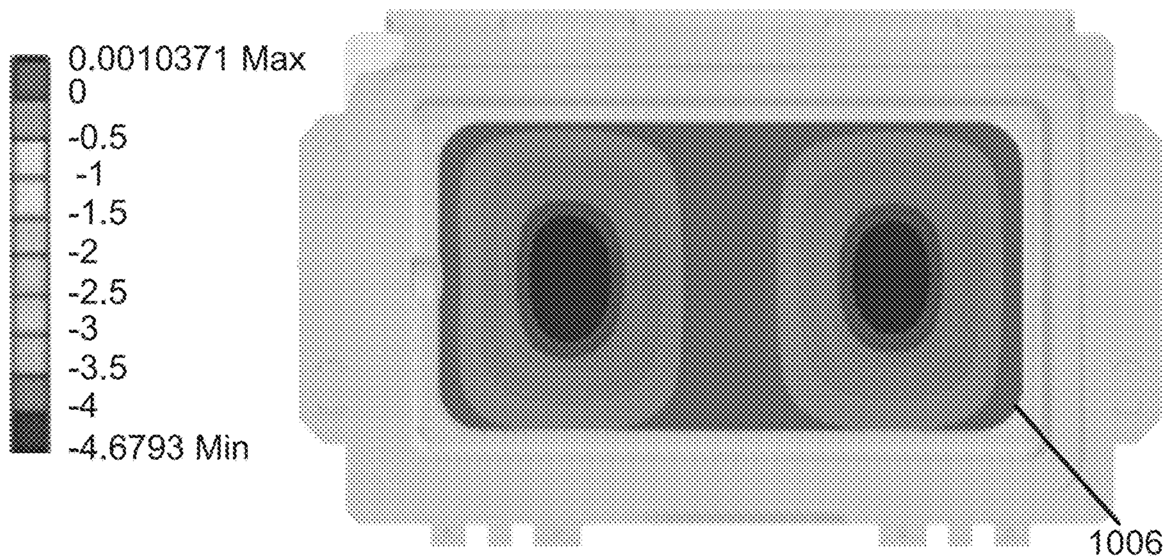

FIG. 31A

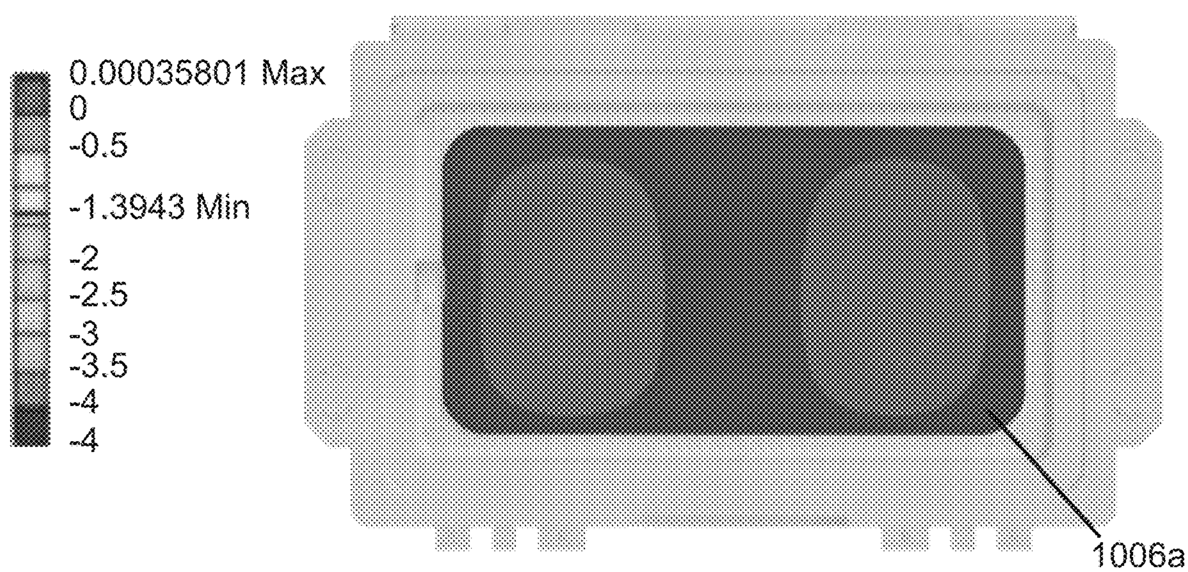

FIG. 31B

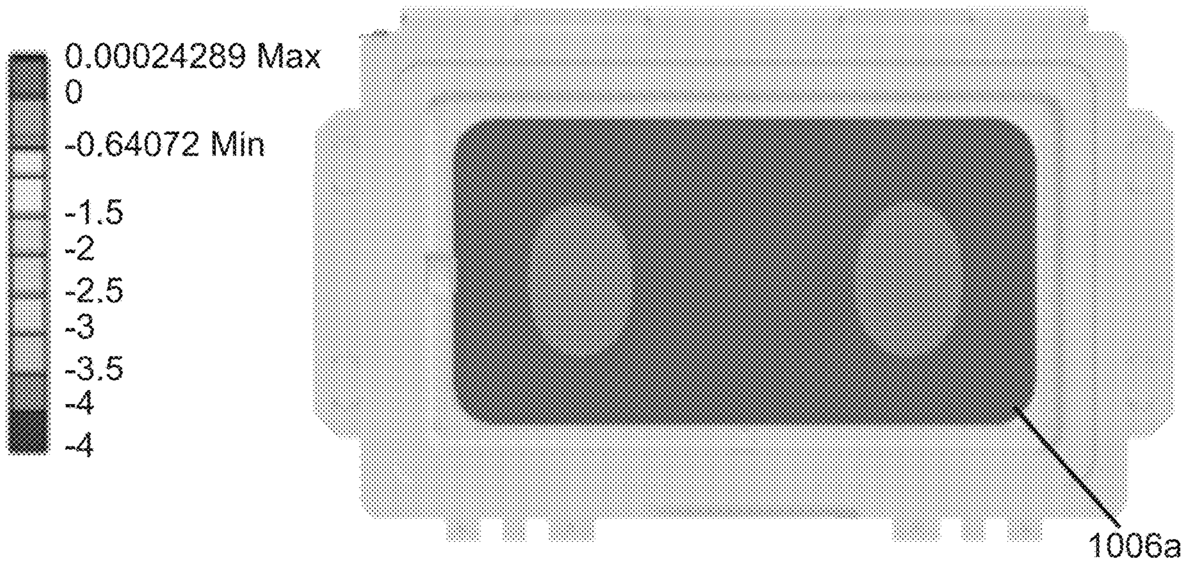

FIG. 31C

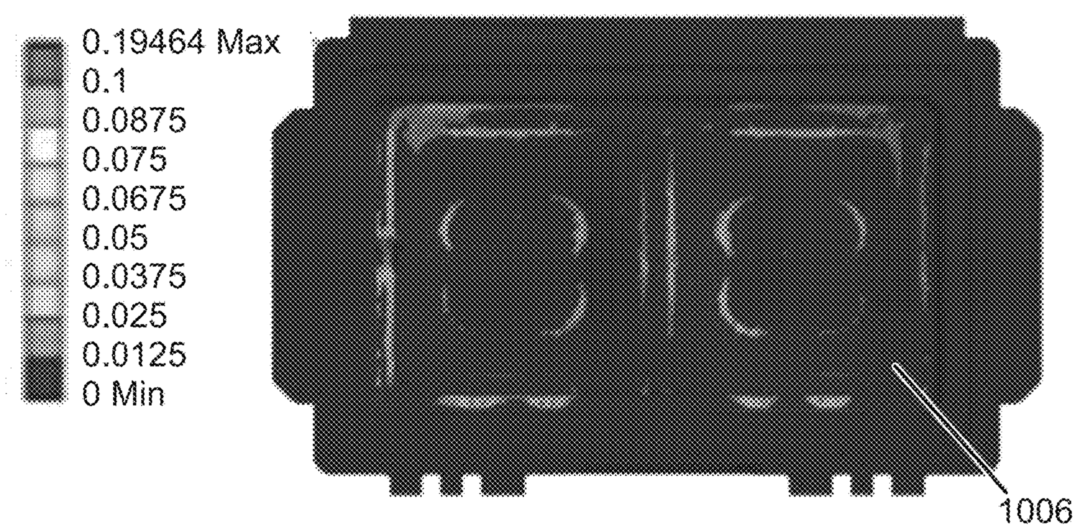

FIG. 32A

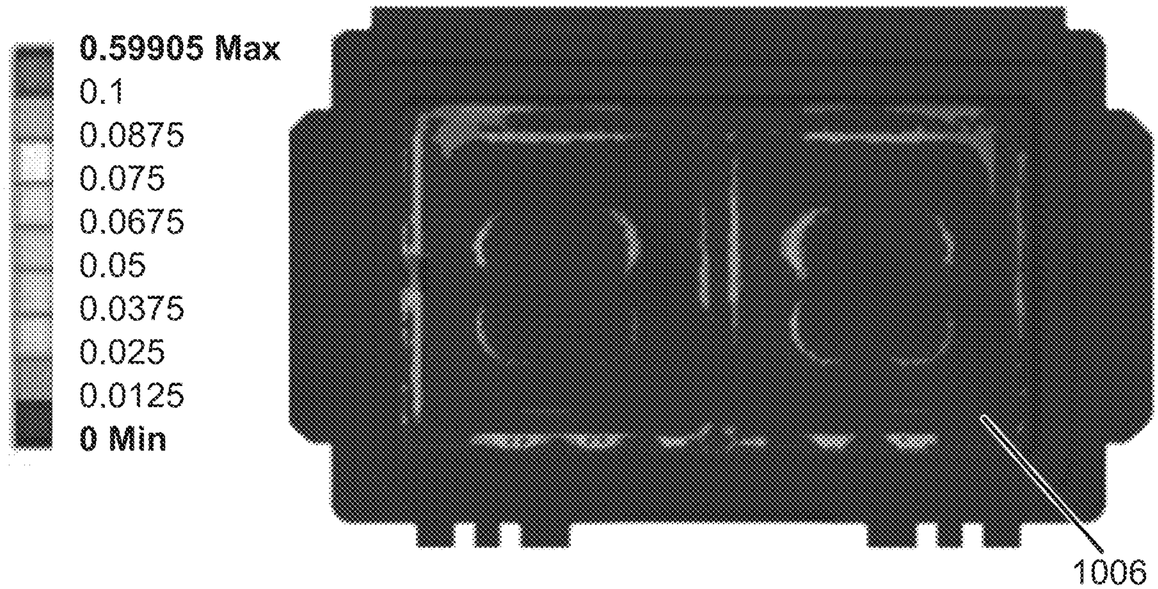

FIG. 32B

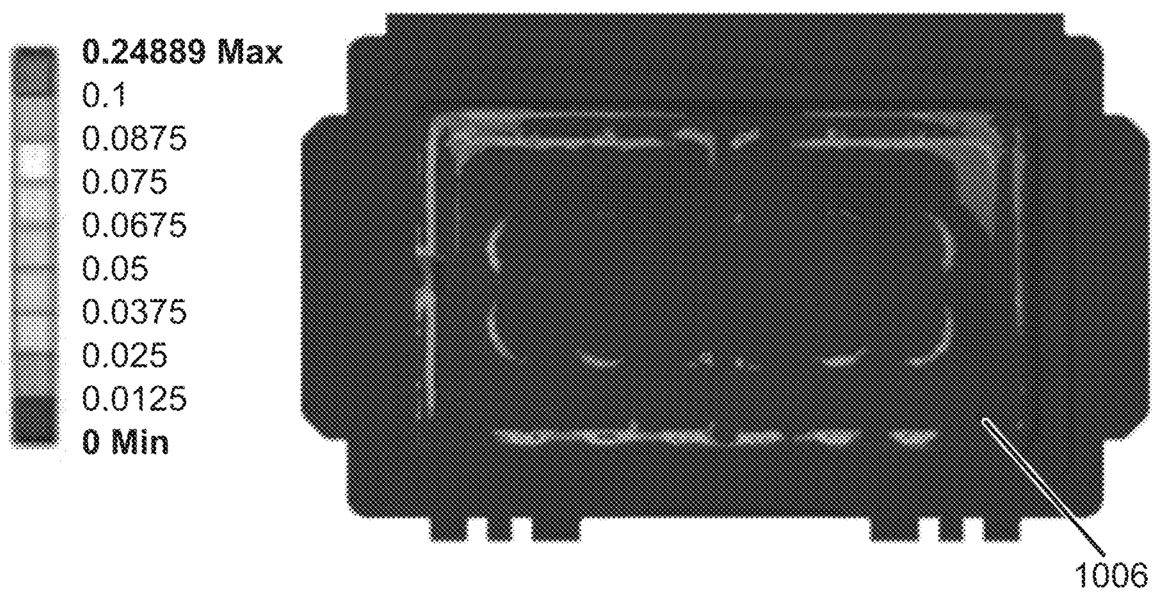

FIG. 32C

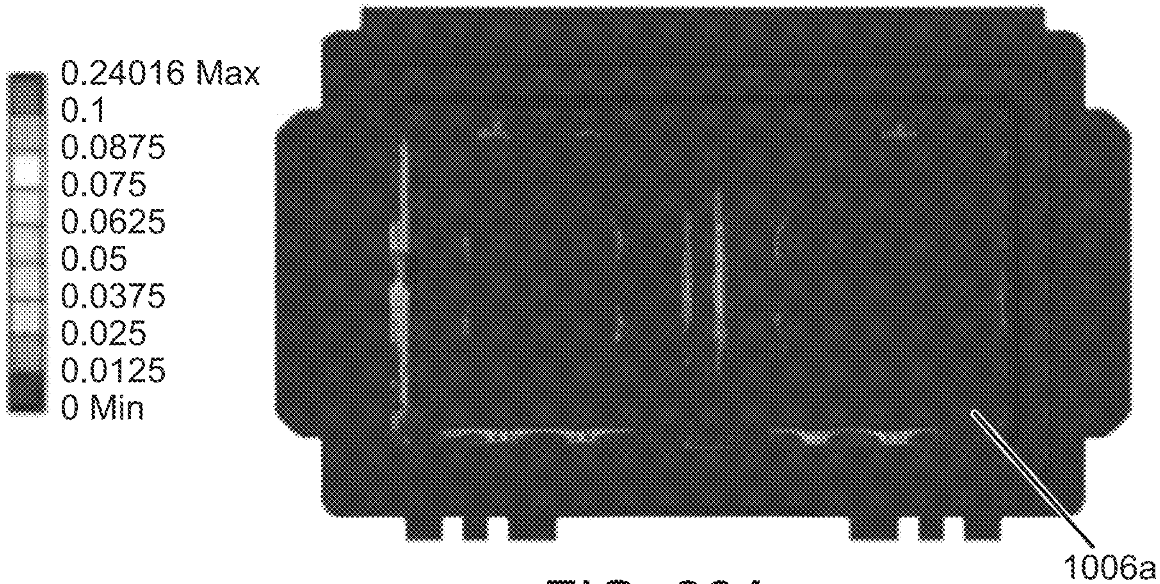

FIG. 33A

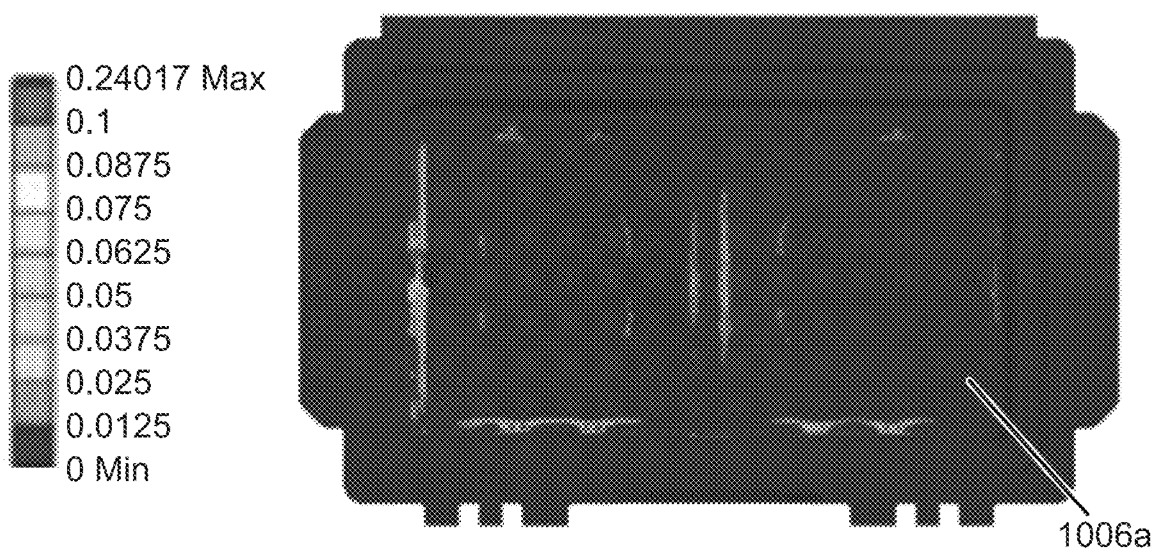

FIG. 33B

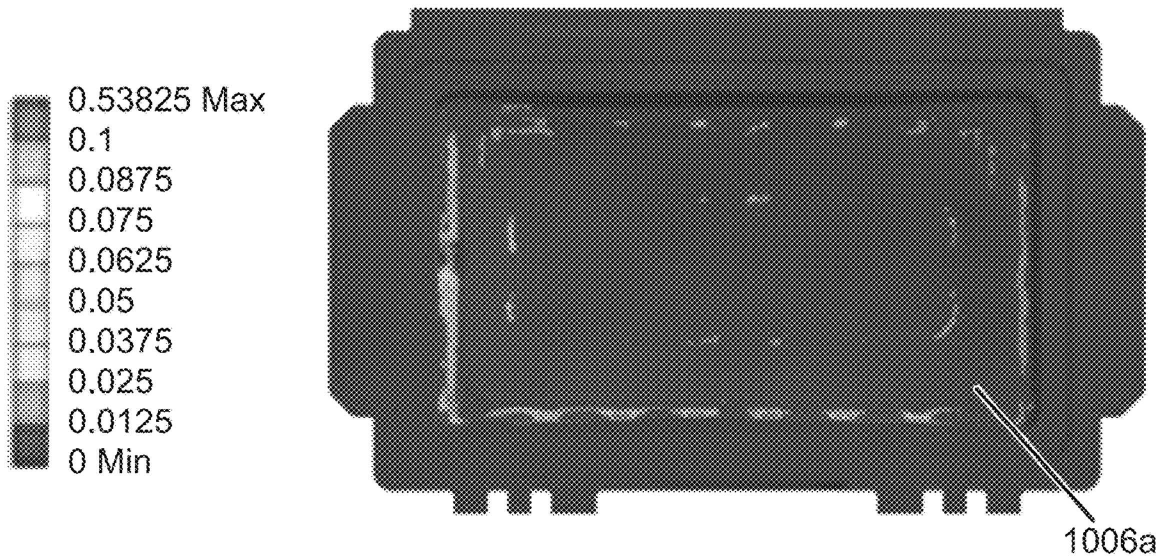

FIG. 33C

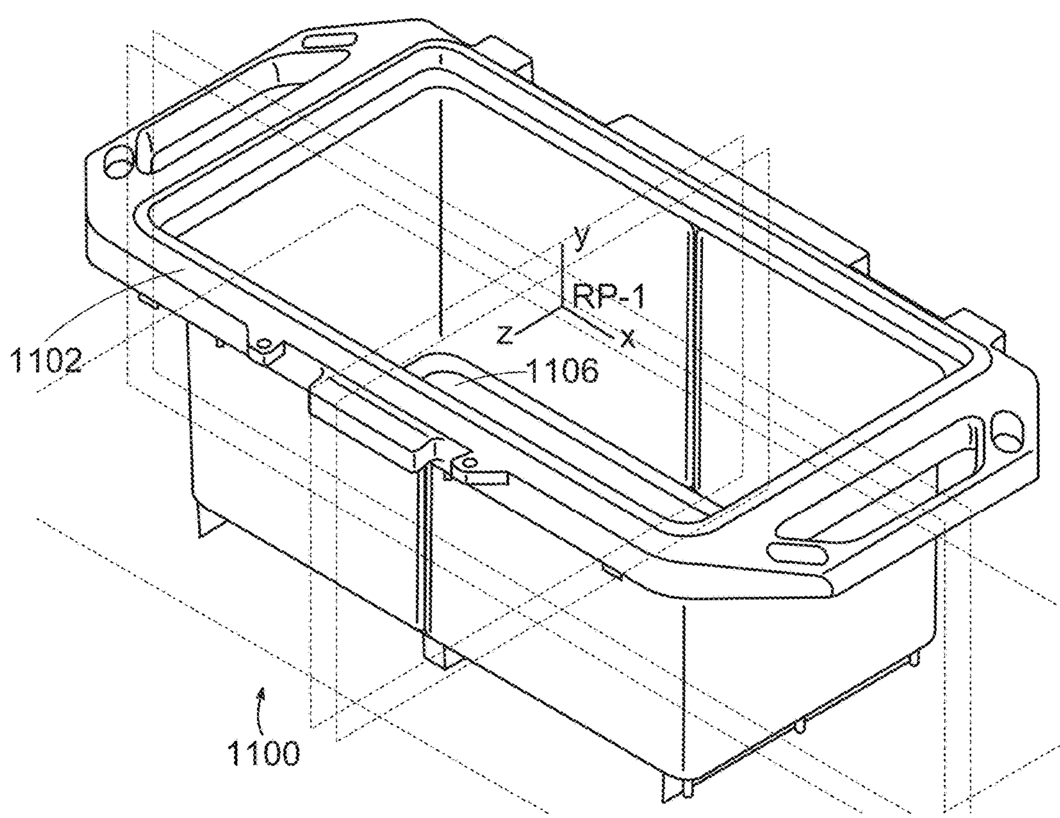

FIG. 34A

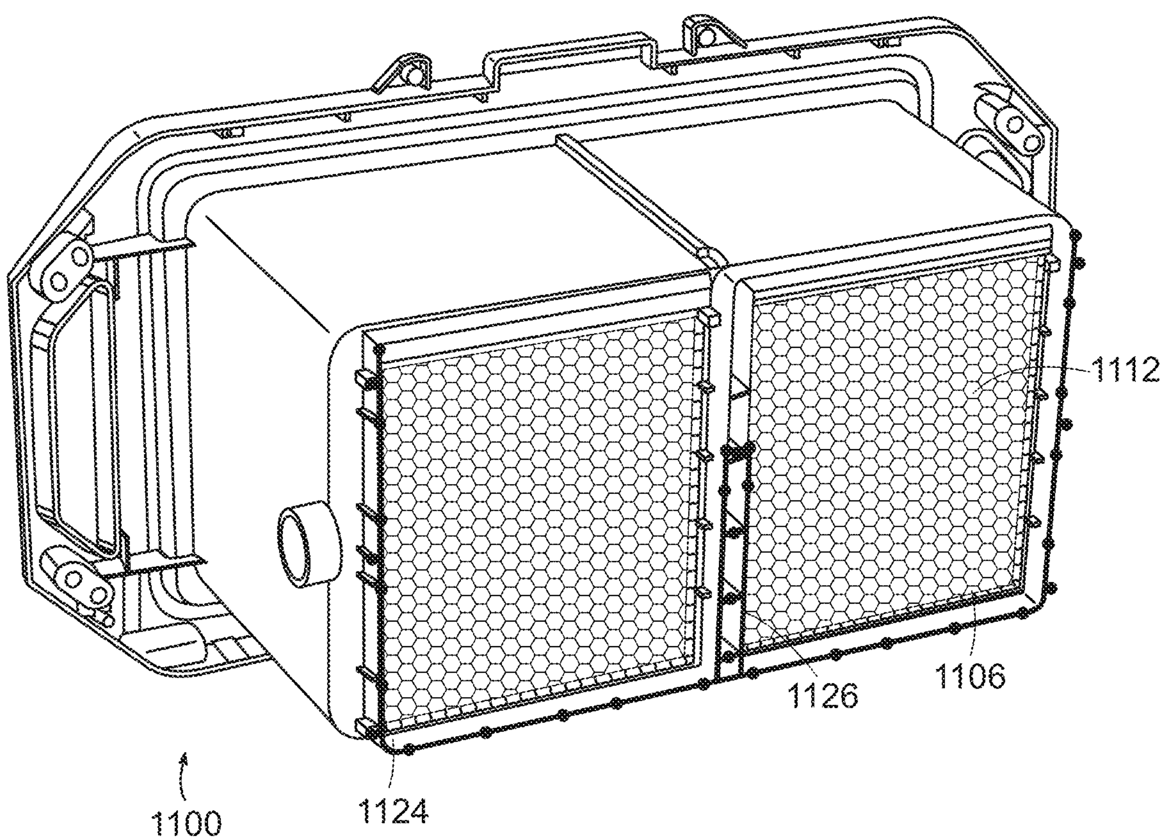

FIG. 34B

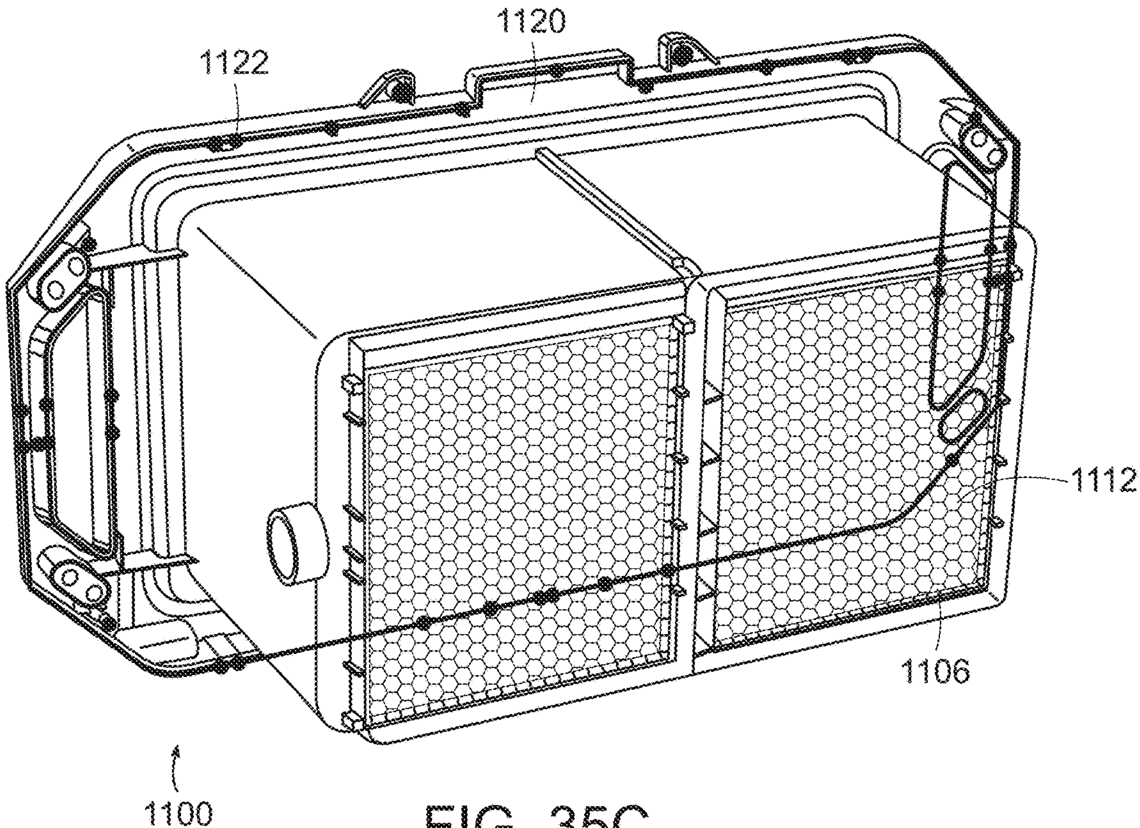

FIG. 35C

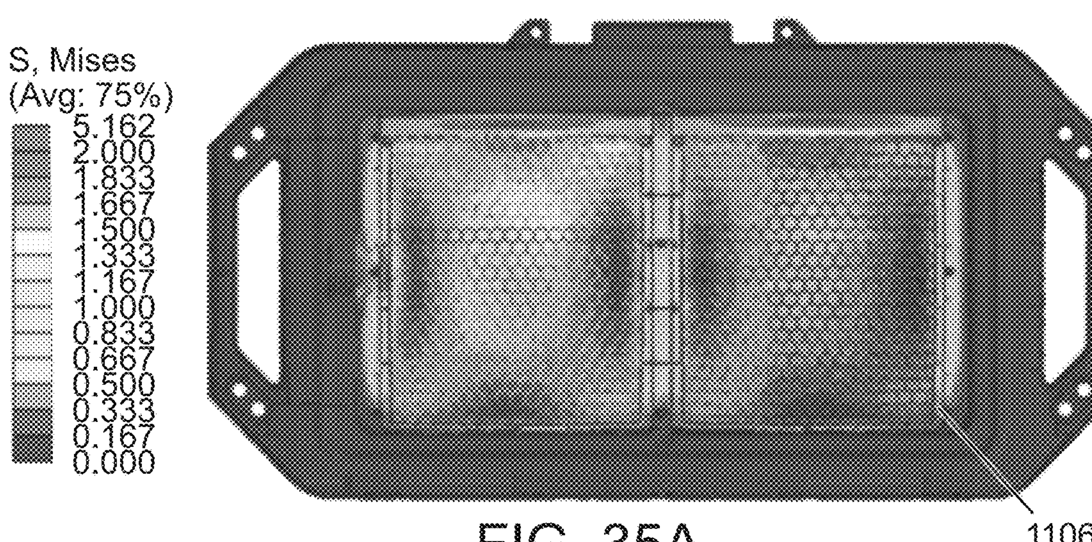

FIG. 35A

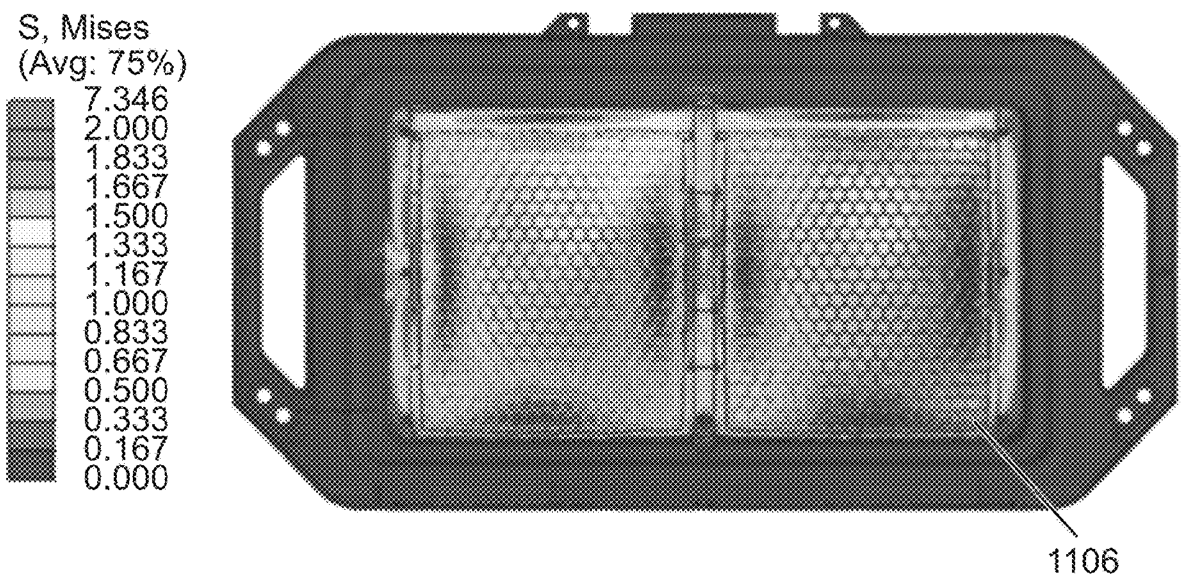
S, Mises
(Avg: 75%)
7.346
2.000
1.833
1.667
1.500
1.333
1.167
1.000
0.833
0.667
0.500
0.333
0.167
0.000
1106

FIG. 35B

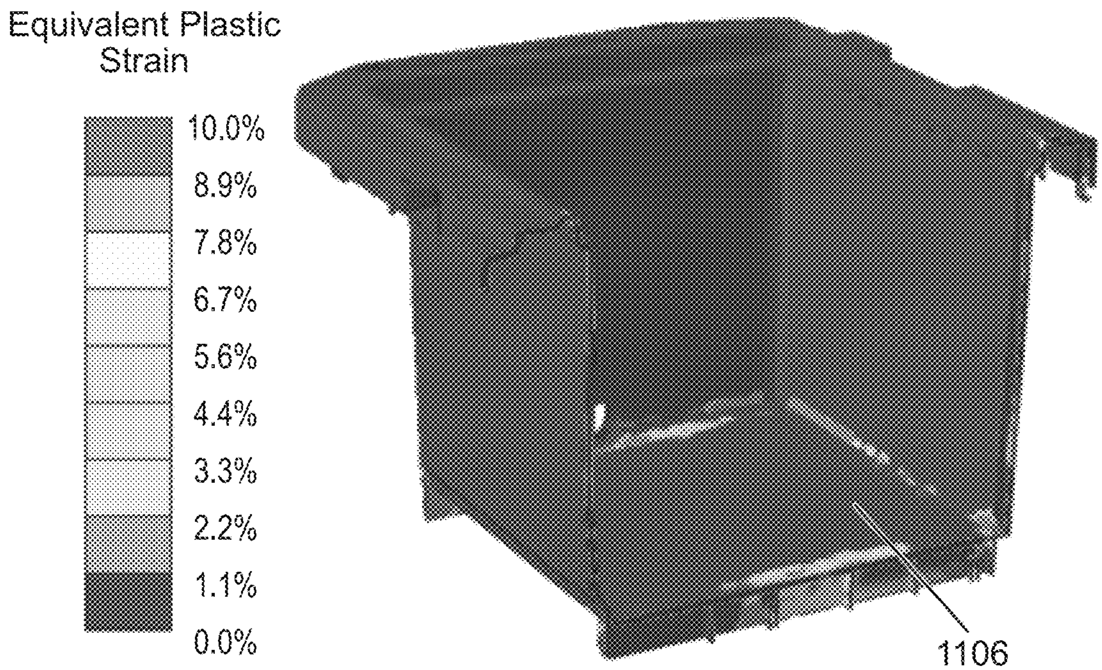

FIG. 36A

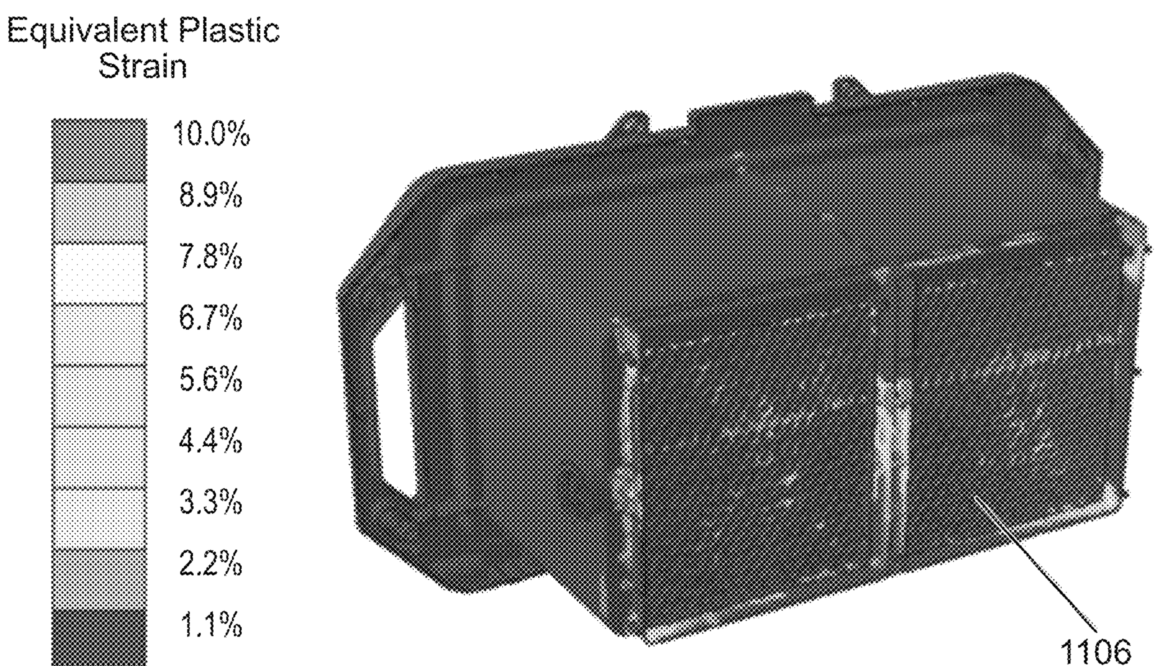

FIG. 36B

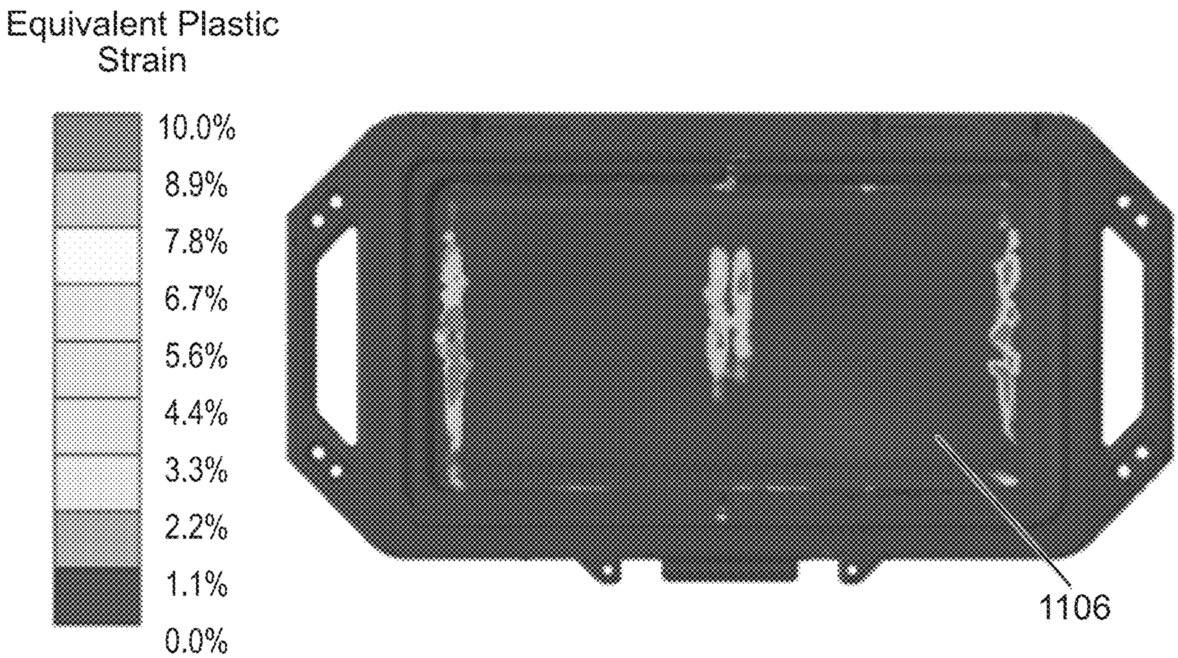

FIG. 36C

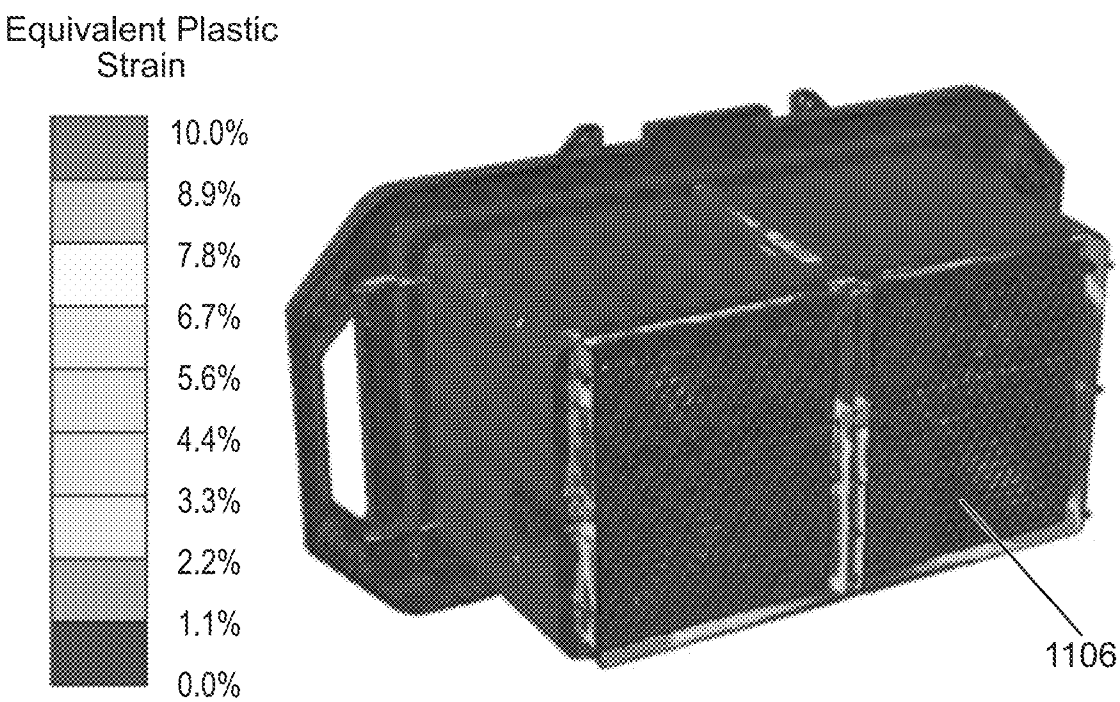

FIG. 37A

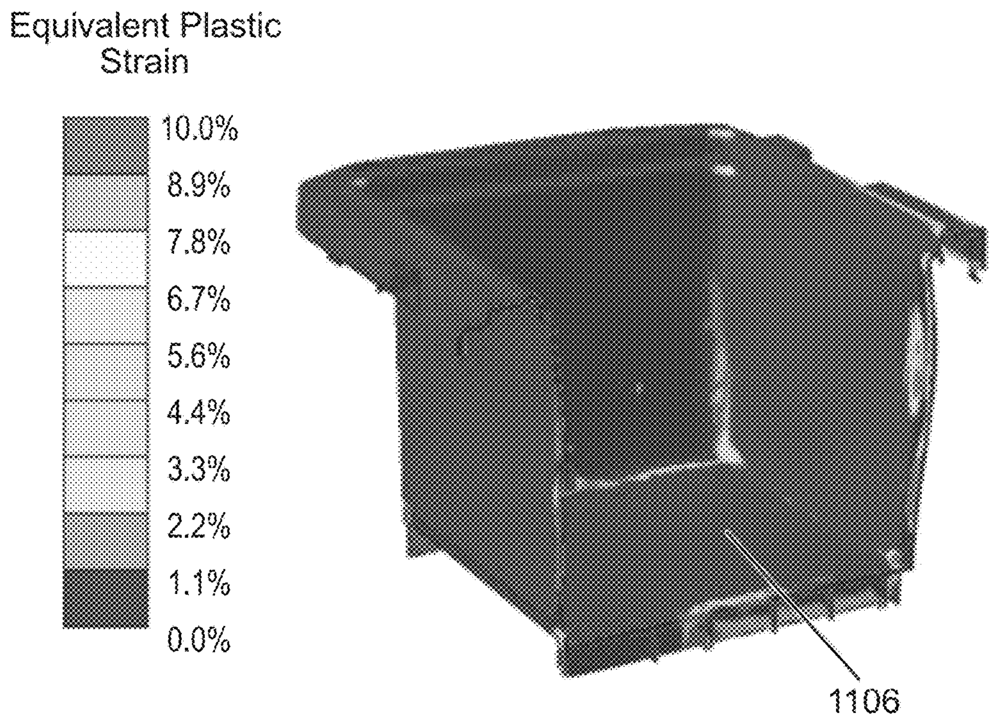

FIG. 37B

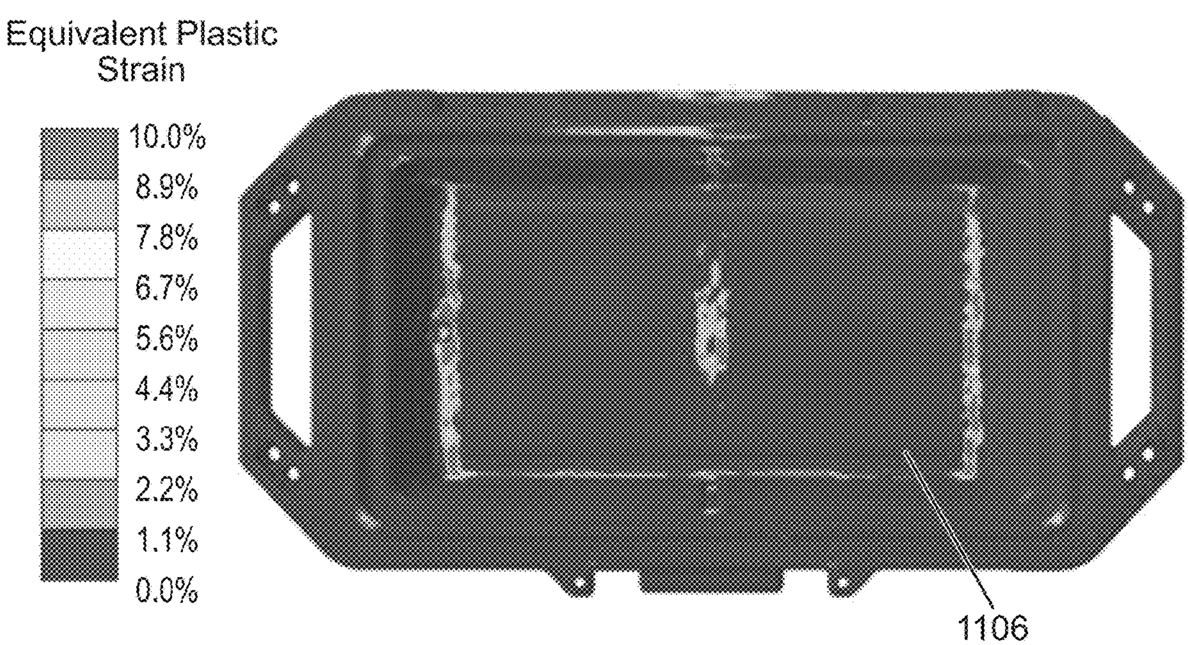

FIG. 37C

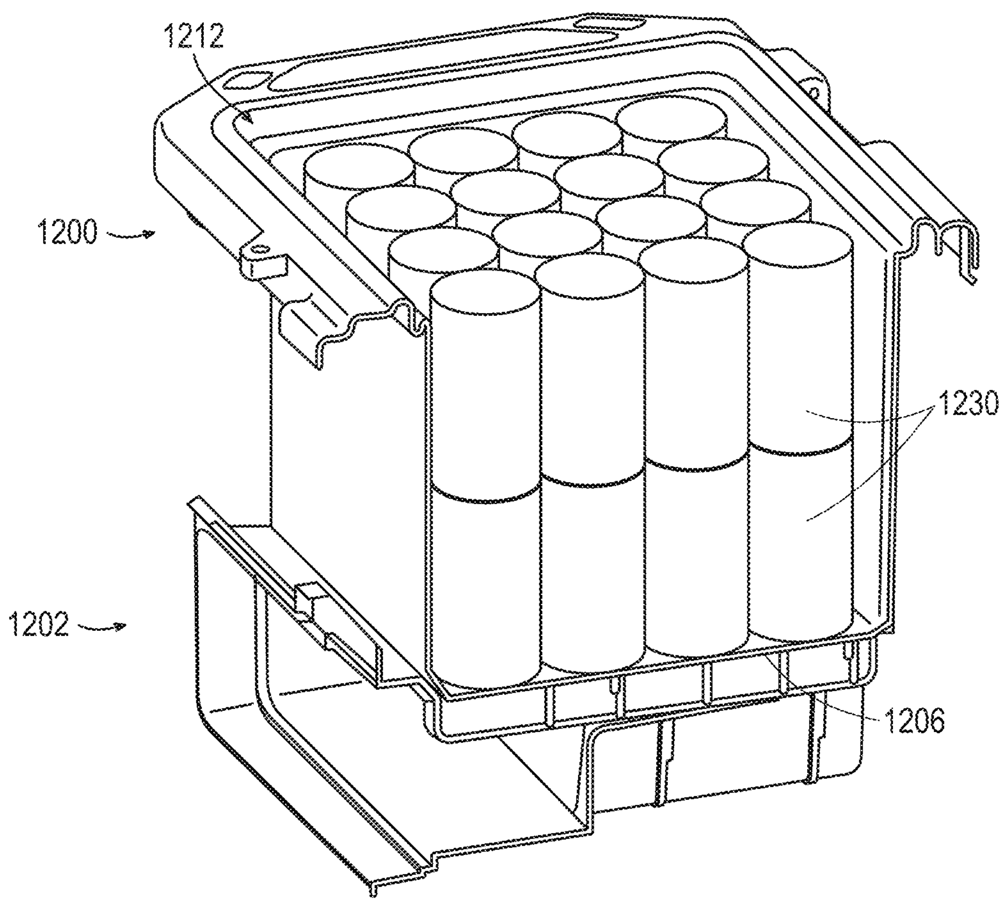

FIG. 38A

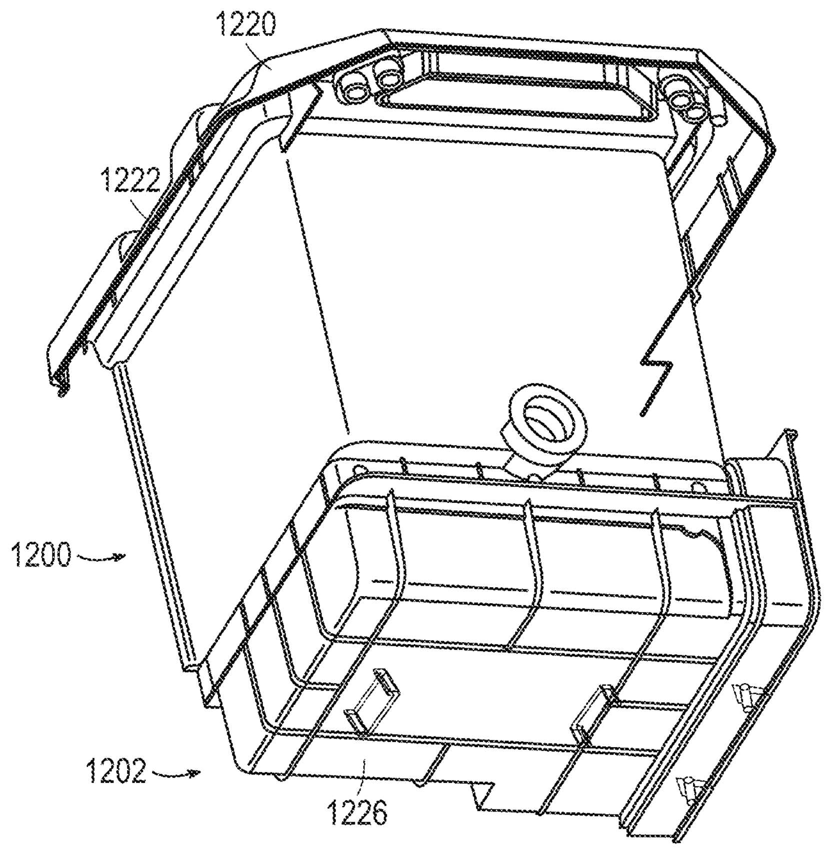

FIG. 38B

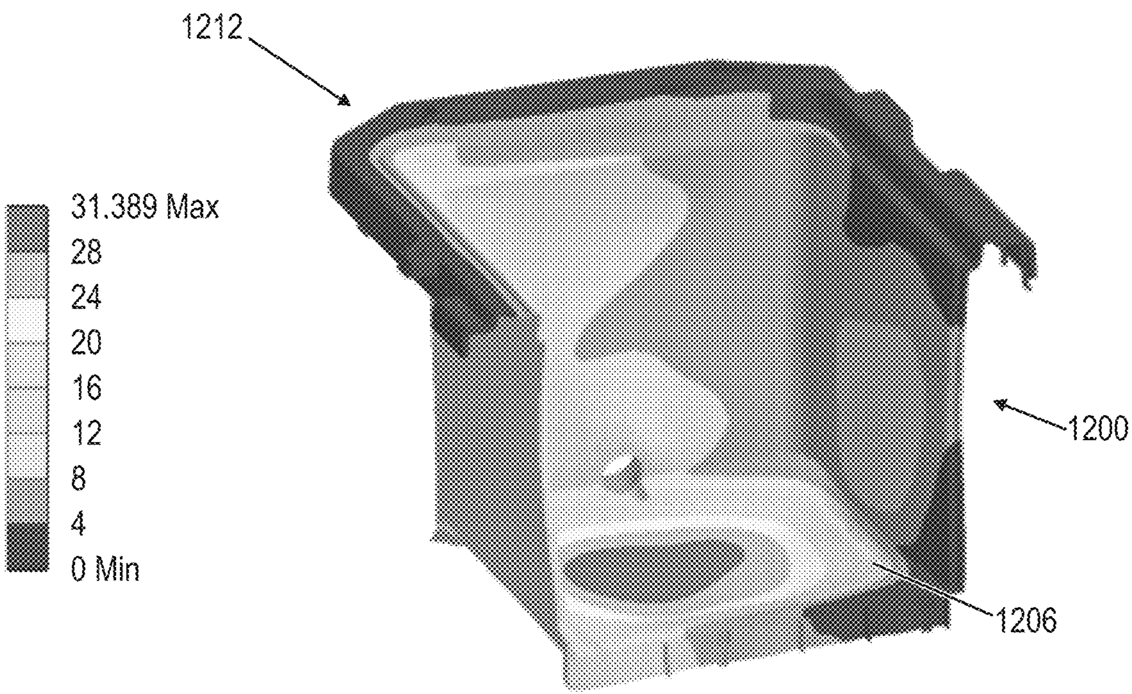

FIG. 39

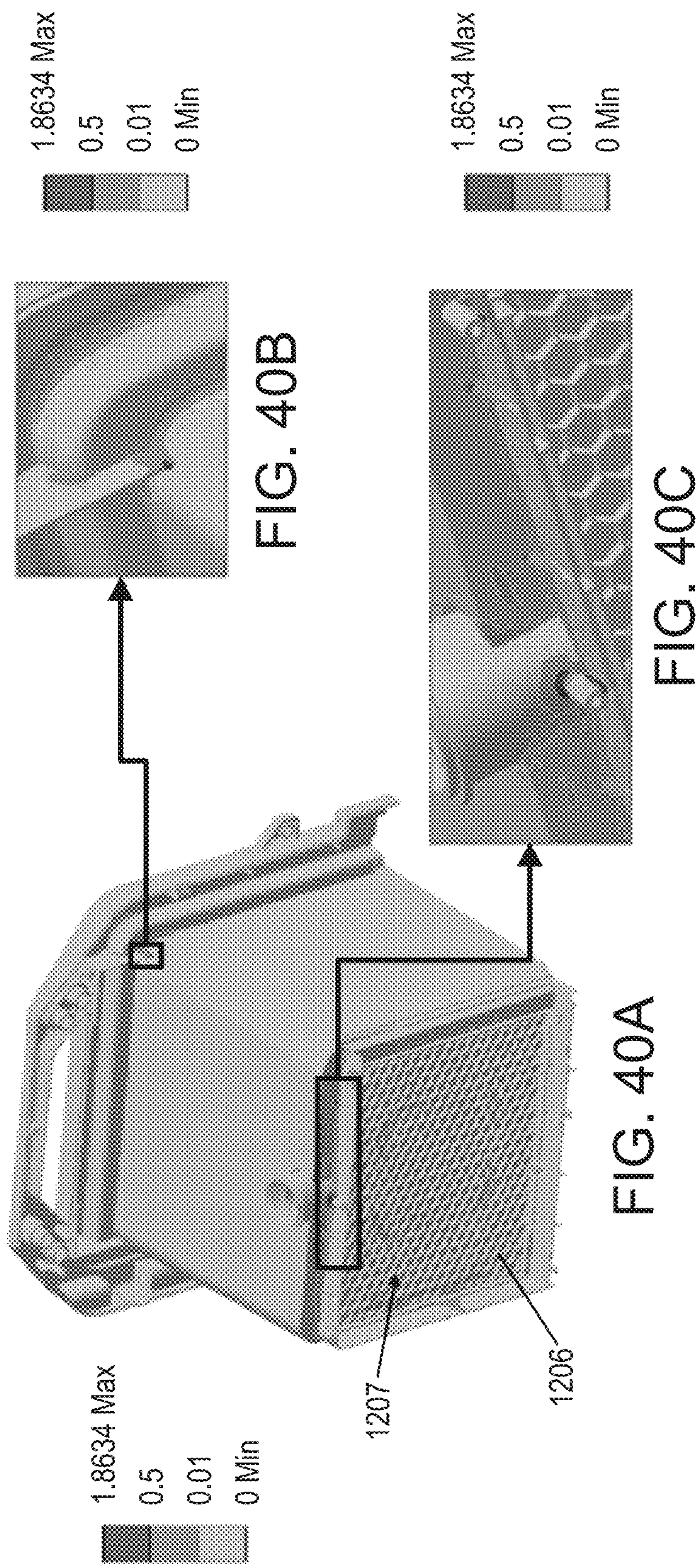

FIG. 40A

FIG. 40B

FIG. 40C

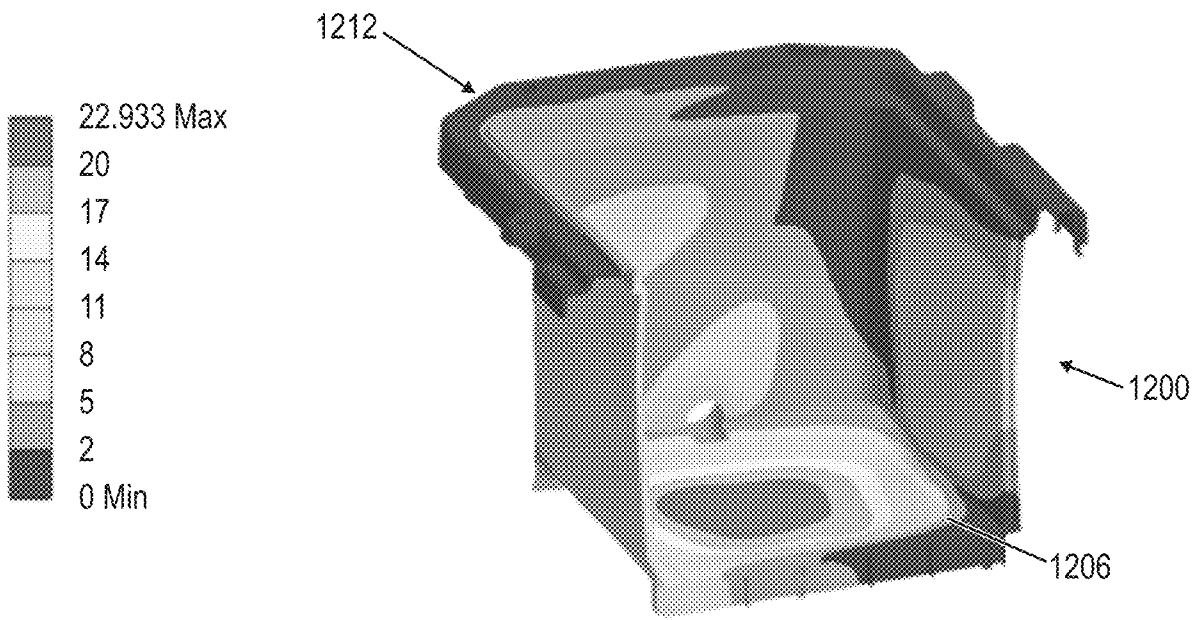

FIG. 41

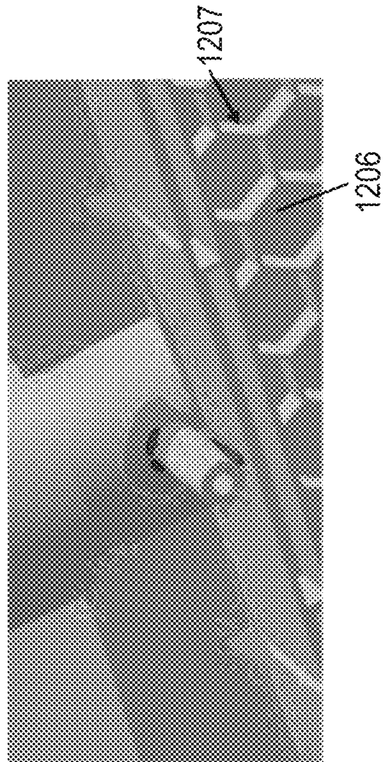

FIG. 42B

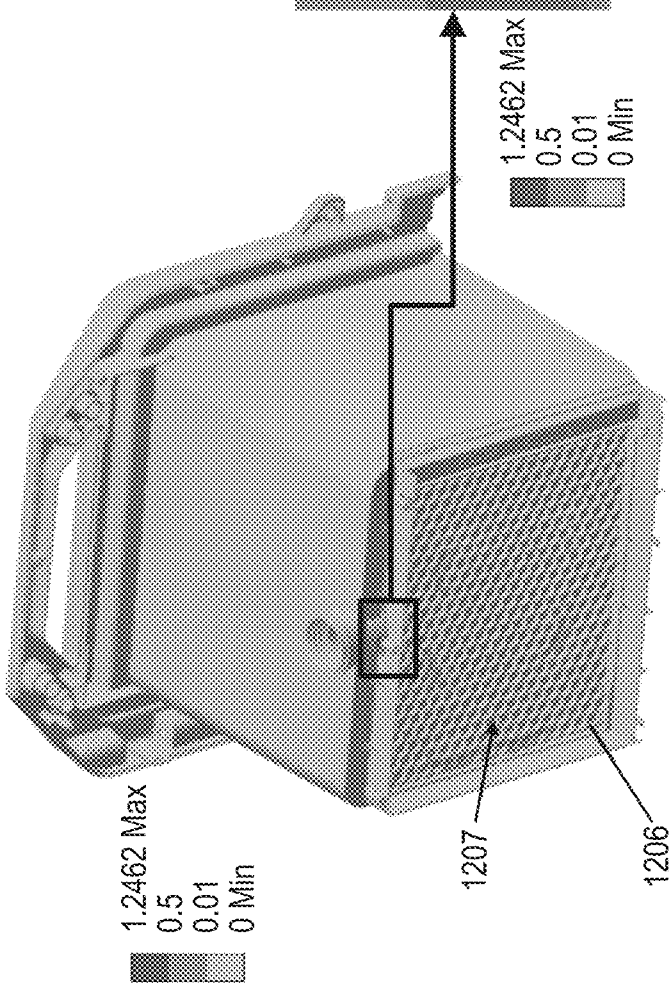

FIG. 42A

INSULATED CONTAINER WITH A DRAWER

CROSS REFERENCE TO RELATED APPLICATIONS

The present application claims priority and is a continuation of PCT Patent Application No. PCT/CN2024/075101 filed Jan. 31, 2024, which claims priority to PCT Patent Application No. PCT/CN2023/119079 filed Sep. 15, 2023, the entire contents of which are hereby incorporated herein by reference in their entireties.

FIELD

The present disclosure generally relates to insulated containers with a drawer.

BACKGROUND

Portable insulated containers such as coolers allow items such as beverages and foods to be kept cold while outdoors, in a vehicle, or otherwise outside a refrigerator or freezer. Portable coolers typically have an insulated internal cavity in which a cooling agent, such as ice or reusable cooler packs, is placed to help cool the items in the cooler. As the cooling agent defrosts or melts, the cooling agent itself and/or condensation from the cooling agent can cause items in the cooler to become wet. An item becoming wet may cause one or more unwelcome effects, such as making items undesirably damp, making items difficult and/or messy to handle unless cleaned with a towel or other material, damaging paper packaging of items, etc.

SUMMARY

In general, systems, devices, and methods for insulated containers with a drawer are provided.

In one aspect, an insulated container is provided that in one embodiment includes an upper housing and a lower housing. The upper and lower housings are separated by a horizontal divider wall formed of a material having a thermal conductivity of about 0.3 W/m K or less. The horizontal divider wall is integrally formed with the upper housing. The horizontal divider wall has a plurality of ribs along a bottom surface of the horizontal divider wall, a thickness between about 7 mm and about 11 mm, and maximum deformation factor of 5 or less when the horizontal divider wall is subjected to a force of between about 1 kPa and about 2 kPa. The deformation factor is determined by dividing a maximum deformation of the horizontal divider wall by the thickness.

The insulated container can vary in any number of ways. For example, the horizontal divider wall can have a total surface area between about 0.1 square meters and about 0.2 square meters, such as about 0.15 square meters. The horizontal divider wall can be formed of polypropylene.

In another example, the insulated container can include a vertical divider wall positioned within the lower housing and arranged to support a central portion of the horizontal divider wall. The vertical divider wall can support between about 0.25 and about 0.75 of a width of the horizontal divider wall in a first configuration. The deformation factor can be 1 or less in the first configuration. The vertical divider wall can support an entire width of the horizontal divider wall in a second configuration. The deformation factor can be 1 or less in the second configuration.

In another aspect, an insulated container is provided that in one embodiment includes an upper housing and a lower housing. The upper and lower housings are separated by a horizontal divider wall formed of a material having a thermal conductivity of about 0.3 W/m K or less. The horizontal divider wall is integrally formed with the upper housing. The horizontal divider wall has a plurality of hexagonal ribs arranged in a honeycomb pattern along a bottom surface of the divider wall, a total surface area between about 0.1 square meters and about 0.2 square meters, and a maximum plastic strain value of 190% or less when the horizontal divider wall is subjected to a dynamic force of between about 1 kPa and about 2 kPa.

The insulated container can vary in any number of ways. For example, the maximum plastic strain can be less than an elongation at failure value. The elongation at failure value can be a strain of about 200%. The horizontal divider wall can be formed of polypropylene.

In another example, the insulated container can include a vertical divider wall positioned within the lower housing and arranged to support a central portion of the horizontal divider wall. The vertical divider wall can support between about 0.25 and about 0.75 of a width of the horizontal divider wall in a first configuration. The vertical divider wall can support an entire width of the horizontal divider wall in a second configuration.

In still another example, the upper and lower housings can be separable from one another. The upper housing can have a first plurality of walls that defines a main chamber arranged to receive a cooling agent therein. The lower housing can have a second plurality of walls that defines a drawer chamber arranged to receive a drawer therein.

In another aspect, an insulated container is provided that in one embodiment includes a housing having a substantially rigid polypropylene horizontal divider, the horizontal divider including a top non-porous surface that can be substantially smooth and a bottom surface having a plurality of ribs defining pores there between, the ribs being arranged in a honeycomb pattern to inhibit vertical deformation of the horizontal divider. In some aspects, the horizontal divider has a first vertical distance as measured between the top surface and the bottom surface within the pores and a second vertical distance as measured between the top surface and the bottom surface at the ribs.

The insulated container can vary in any number of ways. For example, in some aspects, the second distance varies along a length of the horizontal divider and the first distance remains constant along a length of the horizontal divider. In some aspects, the second distance can be between about 7 mm and about 11 mm. In some aspects, the first distance is between about 2.5 mm and 3 mm.

In another example, each rib of the plurality of ribs has a cross-sectional shape selected from the group consisting of a pentagon, a hexagon, and an octagon. In some aspects, at least one rib of the plurality of ribs can be truncated. In another example, the top surface defines a bottom of an upper housing of the insulated container and the bottom surface defines a top of a lower housing of the insulated container. In some aspects, the horizontal divider has a width and a length, the length being greater than the width. In some aspects, the top surface can be slanted horizontally to direct fluid flow towards a drain in the insulated container.

In another aspect, an insulated container is provided that in one embodiment includes a housing having a polypropylene horizontal divider wall, the divider wall having a non-porous upper layer and a porous lower layer. The porous lower layer has at least two pores each having a hexagonal cross-sectional shape. In some aspects, a thickness of the non-porous upper layer can be constant, a thickness of the porous lower layer varies along a length thereof, and the thickness of the porous lower layer can be greater than the thickness of the non-porous upper layer.

In one example, the porous lower layer can be parallel to a bottom wall of the housing. In another example, the non-porous upper layer can be sloped relative a bottom wall of the housing and can be arranged to direct a liquid towards a drain of the housing.

In some aspects, the thickness of the non-porous upper layer can be between about 2.5 mm and 3 mm. In some aspects, the thickness of the porous lower layer ranges from about 4 mm to about 8 mm. In another example, the non-porous upper layer defines a bottom of an upper housing of the insulated container and the porous lower layer defines a top of a lower housing of the insulated container. In yet another example, the horizontal divider wall has a width and a length, the length being greater than the width. In some aspects, the at least two pores can inhibit deformation of the horizontal divider wall.

BRIEF DESCRIPTION OF DRAWINGS

This disclosure will be more fully understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. **1** is a perspective view of one embodiment of an insulated container;

FIG. **2** is another perspective view of the insulated container of FIG. **1**;

FIG. **3** is yet another perspective view of the insulated container of FIG. **1**;

FIG. **4** is a perspective cross-sectional view of the insulated container of FIG. **1**;

FIG. **5** is a back side cross-sectional view of the insulated container of FIG. **1**;

FIG. **6** is another perspective cross-sectional view of the insulated container of FIG. **1**;

FIG. **7** is a yet another perspective cross-sectional view of the insulated container of FIG. **1**;

FIG. **7**A is a partial side cross-sectional view of the insulated container of FIG. **1**;

FIG. **8** is still another perspective cross-sectional view of the insulated container of FIG. **1**;

FIG. **9** is a top side cross-sectional view of the insulated container of FIG. **1**;

FIG. **10** is another perspective cross-sectional view of the insulated container of FIG. **1**;

FIG. **11** is a yet another perspective cross-sectional view of the insulated container of FIG. **1**;

FIG. **12**A is another top side cross-sectional view of the insulated container of FIG. **1**;

FIG. **12**B is a partial perspective side cross-sectional view of the insulated container of FIG. **1**;

FIG. **13** is another perspective cross-sectional view of the insulated container of FIG. **1**;

FIG. **14** is another top side cross-sectional view of the insulated container of FIG. **1**;

FIG. **15** is another perspective view of the insulated container of FIG. **1**;

FIG. **16** is a perspective view of another embodiment of an insulated container;

FIG. **17** is another perspective view of the insulated container of FIG. **16**;

FIG. **18** is yet another perspective view of the insulated container of FIG. **16**;

FIG. **19** is a perspective view of the insulated container of FIG. **16** with a lid open and a drawer open;

FIG. **20** is a perspective view of another embodiment of an insulated container;

FIG. **21** is a perspective view of the insulated container of FIG. **20** with a lid open and a drawer open;

FIG. **22** is a schematic view of a drawer lock of the insulated container of FIG. **20** with the drawer lock in a locked configuration;

FIG. **23** is a schematic view of the drawer lock of FIG. **22** with the drawer lock in an unlocked configuration;

FIG. **24** is a schematic view of a lid lock of the insulated container of FIG. **20** with the lid lock in a locked configuration;

FIG. **25** is a schematic view of the lid lock of FIG. **24** with the lid lock in an unlocked configuration;

FIG. **26** is a perspective view of another embodiment of an insulated container;

FIG. **27**A is a perspective view of an exemplary embodiment of an upper housing of an insulated container;

FIG. **27**B is a bottom view of a first variation of the upper housing of FIG. **27**A;

FIG. **27**C is a bottom view of a second variation of the upper housing of FIG. **27**A;

FIG. **28**A is a bottom view of a support configuration of the upper housing of FIG. **27**A;

FIG. **28**B is a bottom view of another support configuration of the upper housing of FIG. **27**A;

FIG. **28**C is a bottom view of yet another support configuration of the upper housing of FIG. **27**A;

FIG. **29**A is an illustrative plot of deformation of the upper housing of FIG. **27**B;

FIG. **29**B is another illustrative plot of deformation of the upper housing of FIG. **27**B;

FIG. **29**C is yet another illustrative plot of deformation of the upper housing of FIG. **27**B;

FIG. **30**A is an illustrative plot of deformation of the upper housing of FIG. **27**C;

FIG. **30**B is another illustrative plot of deformation of the upper housing of FIG. **27**C;

FIG. **30**C is yet another illustrative plot of deformation of the upper housing of FIG. **27**C;

FIG. **31**A is still another illustrative plot of deformation of the upper housing of FIG. **27**B;

FIG. **31**B is yet another illustrative plot of deformation of the upper housing of FIG. **27**C;

FIG. **31**C is yet another illustrative plot of deformation of an illustrative variation of the upper housing of FIG. **27**C;

FIG. **32**A is an illustrative plot of strain of the upper housing of FIG. **27**B;

FIG. **32**B is another illustrative plot of strain of the upper housing of FIG. **27**B;

FIG. **32**C is yet another illustrative plot of strain of the upper housing of FIG. **27**B;

FIG. **33**A is an illustrative plot of strain of the upper housing of FIG. **27**C;

FIG. **33**B is another illustrative plot of strain of the upper housing of FIG. **27**C;

FIG. **33**C is yet another illustrative plot of strain of the upper housing of FIG. **27**C;

FIG. **34**A is a perspective view of another exemplary embodiment of an upper housing of an insulated container;

FIG. **34**B is a bottom perspective view of the upper housing of FIG. **34**A;

FIG. **34**C is another bottom perspective view of the upper housing of FIG. **34**A;

FIG. **35**A is an illustrative plot of stress of the upper housing of FIG. **34**A;

FIG. **35**B is another illustrative plot of stress of the upper housing of FIG. **34**A;

FIG. **36**A is an illustrative plot of strain from a first dynamic load of the upper housing of FIG. **34**A;

FIG. **36**B is another illustrative plot of strain of the upper housing of FIG. **36**A;

FIG. **36**C is yet another illustrative plot of strain of the upper housing of FIG. **36**A;

FIG. **37**A is an illustrative plot of strain from a second dynamic load of the upper housing of FIG. **34**A;

FIG. **37**B is another illustrative plot of strain of the upper housing of FIG. **37**A;

FIG. **37**C is yet another illustrative plot of strain of the upper housing of FIG. **37**A;

FIG. **38**A is a perspective view of a cross-section of another exemplary embodiment of an upper housing and a lower housing of an insulated container;

FIG. **38**B is a bottom perspective view of upper and lower housings of FIG. **38**A;

FIG. **39** is an illustrative plot of deformation from a first dynamic load of the upper housing of FIG. **38**A;

FIG. **40**A is an illustrative plot of strain from a first dynamic load of the upper housing of FIG. **38**A;

FIG. **40**B is a magnified view of the illustrative plot of strain of FIG. **40**A;

FIG. **40**C is another magnified view of the illustrative plot of strain of FIG. **40**A;

FIG. **41** is an illustrative plot of deformation from a second dynamic load of the upper housing of FIG. **38**A;

FIG. **42**A is an illustrative plot of strain from the second dynamic load of the upper housing of FIG. **38**A; and

FIG. **42**B is a magnified view of the illustrative plot of strain of FIG. **42**A.

DETAILED DESCRIPTION

Certain embodiments will now be described to provide an overall understanding of the principles of the structure, function, manufacture, and use of the devices, systems, and methods disclosed herein. One or more examples of these embodiments are illustrated in the accompanying drawings. Those skilled in the art will understand that the devices, systems, and methods specifically described herein and illustrated in the accompanying drawings are non-limiting embodiments and that the scope of the present invention is defined solely by the claims. The features illustrated or described in connection with one exemplary embodiment can be combined with the features of other embodiments. Such modifications and variations are intended to be included within the scope of the present invention.

Further, in the present disclosure, like-named components of the embodiments generally have similar features, and thus within a particular embodiment each feature of each like-named component is not necessarily fully elaborated upon. Additionally, to the extent that linear or circular dimensions are used in the description of the disclosed systems, devices, and methods, such dimensions are not intended to limit the types of shapes that can be used in conjunction with such systems, devices, and methods. A person skilled in the art will recognize that an equivalent to such linear and circular dimensions can easily be determined for any geometric shape.

Various systems, devices, and methods for insulated containers with a drawer are provided. In general, an insulated container, such as a portable cooler, includes a drawer. The insulated container includes a main chamber and includes a drawer chamber that is separate from the main chamber and is configured to movably receive the drawer therein. The main chamber is configured to hold a cooling agent that is configured to cool any items in the main chamber and also any items in the drawer. The item(s) in the drawer may thus be separated from the cooling agent and not become wet from moisture in the main chamber, e.g., from the cooling agent melting or defrosting. Additionally, the main and drawer chambers being separate from one another allows one of the main and drawer chambers to be opened, e.g., to access item(s) contained therein, without breaking a seal of the unopened one of the drawer and main chambers. A temperature within the unopened one of the drawer and main chambers may thus be prevented from decreasing so as to help maintain effective cooling of the item(s) contained therein.

In an exemplary embodiment, an insulated container is manufactured using injection molding. Using injection molding to manufacture the insulated container may allow for finer details and tolerance control than other manufacturing methods, such as rotomolding. Using injection molding to manufacture the insulated container may allow for individual components of the insulated container to be formed separately. Forming components separately may improve overall structural integrity of each individual component and thus overall structural integrity of the fully assembled insulated container. Forming components separately may improve cooling performance since a singular member does not have seams, joints, or other connection areas that would exist if the singular member was instead formed of two or more parts connected together. Forming components separately may help prevent leaks since a singular member does not have seams, joints, or other connection areas where leaks are most likely to develop.

FIGS. **1-15** illustrate one embodiment of an insulated container **10** that includes a drawer **12**. The insulated container **10** in this illustrated embodiment is a portable cooler. The insulated container **10** is configured to hold therein a cooling agent, such as ice or one or more reusable cooler packs, configured to cool one or more items, such as food, beverages, and medicine, also held in the insulated container **10**.

As discussed further below, the insulated container **10** includes a main chamber **14** (scc for example FIG. **8**) configured to hold the cooling agent therein and includes a drawer chamber **16** that is configured to movably receive the drawer **12** therein (see for example FIG. **13**). The drawer chamber **16** is isolated from the main chamber **14** such that the drawer **12** received in the drawer chamber **16** is also isolated from the main chamber **14**. Thus, as the cooling agent defrosts or melts, the cooling agent itself and/or condensation from the cooling agent cannot wet the item(s) in the drawer **12**. Similarly, a beverage or other item that accidentally spills or leaks in the main chamber **14** cannot wet or otherwise damage any items in the drawer **12**, and vice versa with a beverage or other item that accidentally spills or leaks in the drawer **12** cannot wet or otherwise damage any items in the main chamber **12**.

The drawer chamber **16**, and thus the drawer **12** received therein, is located vertically below the main chamber **14**, e.g., the drawer chamber **16** and the drawer **12** received therein are closer to a bottom of the insulated container **10** than the main chamber **14**. Because gravity tends to draw the cooling agent in the main chamber **14** vertically down, the cooling agent is urged to settle as close as possible to the drawer chamber **16**, and thus the drawer **12** received therein.

Opening one of the main chamber **14** and the drawer chamber **16** causes a temperature inside the open chamber to increase due to ambient outside temperature and thus may reduce effectiveness of the cooling agent's cooling of item(s) contained in the open chamber. The drawer chamber **16** and the main chamber **14** being isolated from each other allows one of the main chamber **14** and the drawer chamber **16** to be opened, e.g., to access item(s) contained therein, without breaking a seal of the unopened one of the drawer chamber **16** and the main chamber **14**. A temperature within the unopened one of the drawer chamber **16** and the main chamber **14** may thus be prevented from decreasing so as to help maintain effective cooling of the item(s) contained therein. Further, if the drawer chamber **16** is the one of the main and drawer chambers **14**, **16** that is opened, the cooling agent in the main chamber **14** will not be exposed to ambient outside air such that the cooling agent's melting or defrosting is not accelerated due to exposure to ambient outside temperature. In other words, opening the drawer **12** to access item(s) therein will not encourage melting or defrosting of the cooling agent in the main chamber **14** like opening of the main chamber **14** does and may therefore prolong effective cooling provided by the cooling agent.

A user may choose to place a cooling agent in the drawer **12** in addition to or instead of in the main chamber **14**. However, a cooling agent does not need to be placed in the drawer **12** to cool any items in the drawer **12** because the insulated container **10** is configured to allow the cooling agent in the main chamber **14** to cool the item(s) in the drawer **12**, as discussed further below.

The insulated container **10** includes an outer housing **18** and a lid **20** movably coupled to the outer housing **18**. The lid **20**, e.g., a bottom outer surface of the lid **20**, defines a top wall of the main chamber **14** (see for example FIG. **4-7**). The lid **20** is configured to move between a closed configuration, in which the main chamber **14** is sealed closed, and an open configuration, in which the main chamber **14** is not sealed closed and the cooling agent and any item(s) removably contained in the main chamber **14** are accessible to a user. In other words, with the lid **20** in the open configuration, a top of the main chamber **14** is open and the main chamber **14** is exposed to ambient outside air. The lid **20** is shown in the closed configuration in FIGS. **1-7** and **15**.

The lid **20** is hingedly and non-removably coupled to the outer housing **18** via a hinge **22**, as shown in FIG. **3** in which the hinge **22** includes two hinges, although another number of hinges (e.g., one, three, etc.) can be used. The hinge **22** is configured to prevent the lid **20** from being fully removed from the outer housing **18**, which may help prevent loss of the lid **20**, may help shield the open main chamber **14** from direct sunlight or other direct heat, and/or may help remind a user to replace the lid **20** when access to the main chamber **14** is no longer needed. In other embodiments, the lid **20** can be non-removably coupled to the lid **20** using another attachment mechanism, such as a flexible tether. In still other embodiments, the lid **20** can be removably attached to the outer housing **18** so as to allow the lid **20** to be fully removed from the outer housing **18**.

The insulated container **10** includes a lid lock **21** configured to lock the lid **20** in the closed configuration. The lid lock **21** is configured to move between, e.g., be manually moved by a user between, a locked configuration, in which the lid **20** is locked in the closed configuration, and an unlocked configuration, in which the lid **20** is allowed to be moved, e.g., be manually moved by a user, from the closed configuration to the open configuration. The lid **20** can thus be prevented from opening accidentally, which may help prevent any contents of the main chamber **14** from spilling out (e.g., during transit of the insulated container **10**, if the insulated container **10** is dropped accidentally, etc.) and may help prevent the main chamber **14** from accidentally being unsealed and thus increasing in temperature. FIGS. **1**, **2**, and **6** show the lid lock **21** in the locked configuration.

The lid lock **21** in this illustrated embodiment includes a movable latch but can have other configurations. A bottom of the lid lock **21** in this illustrated embodiment is pivotally attached to the outer housing **18**. The lid lock **21** is configured to move between the locked and unlocked configurations by pivoting relative to the outer housing **18** and to the lid **20**. A top of the lid lock **21** is configured to releasably engage the lid **20**. In the locked configuration, the top of the lid lock **21** engages the lid **20**. In the unlocked configuration, the top of the lid lock **21** does not engage the lid **20**.

The lid **20** in this illustrated embodiment includes a pair of lock holes **20*h*** corresponding to a pair of lock holes formed in the outer housing **208** (the outer housing's lock holes are obscured in the figures). With the lid **20** closed, the lid's lock holes **20*h*** are configured to align with the outer housing's lock holes. The aligned lid lock holes **20*h*** and outer housing lock holes are configured to receive therethrough a padlock or other locking mechanism (e.g., a zip tie, a rope, etc.) to provide a backup lock of the lid **20** in the closed configuration. The lid **20** and the outer housing **18** each include two lock holes in this illustrated embodiment but can include another number (e.g., one, three, etc.) of lock holes.

The outer housing **18** defines opposed side handles **24** of the insulated container **10**. The opposed side handles **24** are configured to be held to facilitate portability of the insulated container **10**. The insulated container **10** can include another number of side handles **24** and/or have handle(s) at other locations to facilitate portability of the insulated container **10**. The opposed side handles **24** are integrally formed with the outer housing **18** in this illustrated embodiment. In other embodiments the opposed side handles **24** can be separate members attached to the outer housing **18**.

The opposed side handles **24** in this illustrated embodiment each include one or more holes **26** formed therein, as shown in FIG. **15**. Each of the handles **24** includes four openings **26** in this illustrated embodiment but can include another number of openings (e.g., one, two, etc.). In other embodiments, the openings **26** are omitted. The openings **26** are configured to receive a strap, rope, or other member therein configured to facilitate user movement of the insulated container **10**, e.g., by carrying, pulling, etc. The strap, rope, or other member can be non-removably or removably received in the openings **26**. In some embodiments, the insulated container **10** can include at least one wheel, e.g., two wheels at a bottom of the insulated container **10** on either the left or right side thereof, four wheels at a bottom of the insulated container **10** in four corners thereof, etc., configured to allow for rolling movement of the insulated container **10**. A strap, rope, or other member in the openings **26** may help a user achieve such rolling movement. In this illustrated embodiment, the openings **26** are each closed with a cover **28** (see FIG. **1**) releasably coupled to the handles **24**. In some embodiments, the cover **28** is omitted.

The insulated container **10** in this illustrated embodiment includes a front handle **30**. The front handle **30** is configured to facilitate portability of the insulated container **10**, e.g., by carrying, pulling, etc. The front handle **30** in this illustrated embodiment is pivotally attached to the outer housing **18**, which allows the front handle **30** to be positioned flush and unobtrusively against the outer housing **18** when not in use, as shown in FIGS. **1**, **2**, and **6**. The insulated container **10** can include another number of front handles **30** and/or have handle(s) at other locations to facilitate portability of the insulated container **10**. The front handle **30** is a separate member from the outer housing **18**, but in some embodiments, the front handle **30** is formed integrally with the outer housing **18** similar to the opposed side handles **24** shown in FIGS. **1-5** and **15**.

The outer housing **18** has a front wall **18***a*, a back wall **18***b*, a left side wall **18***c*, a right side wall **18***d*, and a bottom wall **18***e*, as shown in FIGS. **1-4**. The front wall **18***a*, the back wall **18***b*, the left side wall **18***c*, the right side wall **18***d*, and the bottom wall **18***e* define an interior cavity of the outer housing **18**. The outer housing **18**, and thus the interior cavity, has an open top configured to be selectively covered by the lid **20**. Each of the front wall **18***a*, the back wall **18***b*, the left side wall **18***c*, and the right side wall **18***d* of the outer housing **18** extends vertically. The bottom wall **18***e* of the outer housing **18** extends horizontally. In an exemplary embodiment, each of the front wall **18***a*, the back wall **18***b*, the left side wall **18***c*, the right side wall **18***d*, and the bottom wall **18***e* have a thickness in a range of about 2.5 to about 3.5 mm. In some variations, the thickness of any of the walls described herein can be greater than 3.5 mm. For example, the thickness of any of the walls can be between about 2.5 mm and about 11 mm.

The insulated container **10** includes an upper housing **32** and a lower housing **34** each configured to be disposed within the outer housing **18** such that the upper and lower housings **32**, **34** are contained within the outer housing **18**. The upper housing **32** has the main chamber **14** therein. The lower housing **34** has the drawer chamber **16** therein. The upper and lower housings **32**, **34** are separate housings from one another, which facilitates the independence of the main and drawer chambers **14**, **16** discussed herein. The upper and lower housings **32**, **34** being separate housings from one another also allows the upper and lower housings **32**, **34** to be separately molded, as discussed further below.

The upper housing **32** has a front wall **32***a*, a back wall **32***b*, a left side wall **32***c*, a right side wall **32***d*, and a bottom wall **32***c*. The front wall **32***a*, the back wall **32***b*, the left side wall **32***c*, the right side wall **32***d*, and the bottom wall **32***e* define the main chamber **14**. The upper housing **32**, and thus the main chamber **14**, has an open top configured to be selectively covered by the lid **20**. Each of the front wall **32***a*, the back wall **32***b*, the left side wall **32***c*, and the right side wall **32***d* of the upper housing **32** extends vertically and is substantially planar. A person skilled in the art will appreciate that an element may not be precisely planar but nevertheless considered to be substantially planar for any number of reasons, such as manufacturing tolerances or sensitivity of measurement equipment. The bottom wall **32***e* of the upper housing **32** extends horizontally and is substantially planar. In an exemplary embodiment, each of the front wall **32***a*, the back wall **32***b*, the left side wall **32***c*, and the right side wall **32***d* have a thickness in a range of about 2.5 to about 3.5 mm. A person skilled in the art will appreciate that a value may not be precisely at a certain value but nevertheless considered to be about that value for any number of reasons, such as manufacturing tolerances or sensitivity of measurement equipment.

The thickness of the bottom wall **32***e* (illustrated in FIG. **12**B as **32***t*) can be equal to or greater than a thickness of any other sidewall of the upper housing **32**. For example, the thickness of the bottom wall **32***e* can be between about 2.5 mm and about 11 mm, about 5 mm and about 10 mm, about 2.5 mm and about 8.5 mm, about 7 mm and about 11 mm, or about 7 mm and about 8 mm. In an exemplary variation, the thickness of the bottom wall **32***e* can be between about 7 mm and about 11 mm. The thickness of the bottom wall **32***e* includes a height of one or more ribs that extend along side one or more pores **32***p*, as described in further detail below and with reference to FIGS. **11**, **12**A, and **12**B. The thickness of the bottom wall **32***e* can vary. For example, a first portion of the bottom wall **32***e* can have a first thickness and a second portion of the bottom wall **32***e* can have a second thickness. In an exemplary embodiment, the first thickness is about 10.3 mm and the second thickness is about 7.7 mm. The second portion having the second thickness can be adjacent to a drain **44**, which will be described further below in reference to FIG. **4**. The varying thickness of the bottom wall **32***e* facilitates a slanted (e.g., sloped) upper surface thereof, such that any liquids in contact with the bottom wall **32***e* flow towards the drain **44**. The bottom surface of the bottom wall **32**, including the outer surfaces of the pores **32***p* and surfaces of any channels defined thereby, is parallel to a bottom wall of the insulated container.

The bottom wall **32***e* can have a length and a width. The length can be between about 100 mm and about 1000 mm, about 300 mm and about 800 mm, or about 500 mm and about 600 mm. In an exemplary variation, the length is about 549 mm. The width can be between about 100 mm and about 1000 mm, about 100 mm and about 500 mm, or about 200 mm and about 300 mm. In an exemplary variation, the width is about 278 mm. A surface area can be calculated based on the length and width of the bottom wall **32***e*. For example, the surface area of the bottom wall **32***c* can be between about 0.05 square meters and about 1 square meter, about 0.1 square meters and about 0.5 square meters, or about 0.1 square meters and about 0.2 square meters. In an exemplary variation, the surface area of the bottom wall **32***e* can be about 0.151 square meters. A person skilled in the art will appreciate that a value may not be precisely at a certain value but nevertheless considered to be about that value for any number of reasons, such as manufacturing tolerances or sensitivity of measurement equipment.

In an exemplary embodiment, the upper housing **32** (e.g., the front wall **32***a*, the back wall **32***b*, the left side wall **32***c*, the right side wall **32***d*, and the bottom wall **32***c*) is formed of polypropylene. In an exemplary embodiment, the upper housing **32** is rigid, such as when formed of polypropylene, which may help provide structural integrity to the insulated container **10**.

The main chamber **14** defined by the upper housing **32** is a single cavity. The insulated container **10** includes a first divider wall **36** disposed in the main chamber **14** that divides the single cavity of the main chamber **14** into first and second compartments **14***a*, **14***b*. Dividing the main chamber **14** into multiple compartments may improve user experience by allowing item(s) in the main chamber **14** to be more easily located. The first divider wall **36** extends vertically and is substantially planar. The first divider wall **36** is centered laterally in the main chamber **14** so as to divide the main chamber **14** substantially in half such that each of the first and second compartments **14***a*, **14***b* are substantially the same size.

The first divider wall **36** can either be removably disposed in the upper housing **32** or can be non-removably disposed in the upper housing **32**. The first divider wall **36** is a separate member from the upper housing **32** in this illustrated embodiment, which may facilitate molding of the upper housing **32**, as discussed further below. In some embodiments, the first divider wall **36** is formed integrally with the upper housing **32**.

The lower housing **34** has a back wall **34***b*, a left side wall **34***c*, a right side wall **34***d*, and a bottom wall **34***c*. The back wall **34***b*, the left side wall **34***c*, the right side wall **34***d*, and the bottom wall **34***c* define the drawer chamber **16**. Each of the back wall **34***b*, the left side wall **34***c*, and the right side wall **34***d* of the lower housing **34** extends vertically and is substantially planar. The bottom wall **34***c* of the lower housing **34** extends horizontally and is substantially planar. In an exemplary embodiment, each of the back wall **34***b*, the left side wall **34***c*, the right side wall **34***d*, and the bottom wall **34***c* have a thickness in a range of about 2.5 to about 3.5 mm.

In an exemplary embodiment, the lower housing **34** (e.g., the back wall **34***b*, the left side wall **34***c*, the right side wall **34***d*, and the bottom wall **34***c*) is formed of polypropylene. In an exemplary embodiment, the lower housing **34** is rigid, such as when formed of polypropylene, which may help provide structural integrity to the insulated container **10**.

The lower housing **34** has an open top. With the lower housing **34** attached to the upper housing **32**, the bottom wall **32***e* of the upper housing **32** defines a top of the drawer chamber **16**, as shown in FIGS. **4**-**7**. The bottom wall **32***e* is non-porous such that liquid or other material cannot enter the drawer chamber **16** (or the drawer **12** therein) from the main chamber **14** through the bottom wall **32***c*. The bottom wall **32***e* is configured to allow the cooling agent in the main chamber **14** to cool the one or more items contained in the drawer chamber **16**. e.g., in the drawer **12** received in the drawer chamber **16**. The bottom wall **32***e* being formed of polypropylene and having a thickness in a range of about 2.5 to about 11 mm allows the bottom wall **32***e* to be thick enough to provide durability and thin enough to provide effective cooling therethrough from the main chamber **14** to the drawer chamber **16**, e.g., to allow a typical cooling agent in the main chamber **14** to cool the drawer chamber **16** (and thus the drawer **12** therein) to below about 40° F.

The bottom wall **32***e* can, as in this illustrated embodiment, be configured to be strong enough that the bottom wall **32***c* resists deflecting downward into the drawer chamber **16**, even under the weight of the cooling agent and items located in the main chamber **14**. In some embodiments, the bottom wall **32***c* can, as in this illustrated embodiment, be configured to be strong enough, in combination with the load-bearing strength of second divider wall **38**, that the bottom wall **32***e* resists deflecting downward into the drawer chamber **16**, even under the weight of the cooling agent and items located in the main chamber **14**. Being formed from a rigid material, such as when formed of polypropylene, is configured to help provide strength to the bottom wall **32***c*. Additionally, with the bottom wall **32***e* being formed of polypropylene, instead of a metal, the conductive properties of polypropylene are configured to, if the drawer **12** is opened, help prevent the bottom wall **32***e* from rapidly heating from warm or hot air in the drawer chamber **16** and/or the drawer **12** and conducting warm energy to the main chamber **14** from the drawer chamber **16**. The bottom wall **32***e* being formed of polypropylene may also prevent the bottom wall **32***e* from rapidly heating from warm or hot air in the main chamber **14** is the lid **20** is opened, and thus help prevent conducting warm energy to the drawer chamber **16** from the main chamber **14**, but the bottom wall **32***e* is less susceptible to rapid heating if the lid **20** is opened than if the drawer **12** is opened because of the cooling agent located in the main chamber **14** and because gravity tends to settle the cooling agent on or toward the bottom wall **32***c*. Accordingly, the insulated container can be made of a material having thermal properties suitable for the heat transfer described herein. For example, the bottom wall **32***e* can have a thermal conductivity between about 0.1 W/m K and about 0.5 W/m K, about 0.2 W/m K and about 0.3 W/m K, or about 0.3 W/m K or less. In an exemplary variation, the bottom wall **32***c* can have a thermal conductivity of about 0.2 W/m K.

The structural rigidity of the bottom wall **32***e*, or any other wall described herein, can be quantified using physical tests and/or computational analysis. For example, finite element analysis can be used to calculate one or more of a deformation magnitude, von Mises stress, plastic strain, and any other structural characteristic. In an exemplary variation, the bottom wall **32***c*, which can be integrally formed with one or more of the front wall **32***a*, the back wall **32***b*, the left side wall **32***c*, the right side wall **32***d*, can be formed of polypropylene. Polypropylene typically has a density of about 900 kg/m^3, an clastic modulus of about 1000 MPa, a Poisson's ratio of about 0.4, a yield strength of about 22 MPa, and an elongation at failure of about 200%. Structural tests can be performed based on a variety of use cases. The performance of the insulated containers described herein, including the bottom wall **32***e* or any other bottom wall in accordance with the description provided herein, can be evaluated under a static load condition and/or a dynamic load condition. For example, a static force, such as a force due to a plurality of cans, a fluid, or any other object positioned within the main chamber **14**, can be applied to a top surface of the bottom wall **32***e*. The force can be between about 0.01 kPa and about 5 kPa, about 0.5 kPa and about 3 kPa, or about 1 kPa and about 2 kPa. The bottom wall **32***e* can be configured to elastically and/or inelastically deform without failing (e.g., rupturing, breaking, forming a hole therethrough). The amount of deformation can be characterized using Equation 1:

$$DF = \frac{D_{max,wall}}{t_{wall}} \qquad \text{Equation 1}$$

In Equation 1, a deformation factor (DF) is calculated based on a maximum deformation of the bottom wall **32***c*, $D_{max,wall}$, and a thickness of the bottom wall **32***e*, t_{wall}. A relatively higher DF value can indicate a greater amount of deflection per unit thickness, and a relatively lower DF value can indicate a lesser amount of deflection per unit thickness. The insulated containers described herein are configured to have an optimal DF value (e.g., below a DF value of about 5) while maintaining a relatively low mass so that the user can easily maneuver the insulated container and optimal thermal conductivity properties to facilitate cooling of one or more objects contained therein without transferring heat to an external environment.

As in this illustrated embodiment, the bottom wall **32***e* can include a plurality of layers. The layers in this illustrated embodiment includes a first layer L**1**, which may be referred to as a top surface, and a second layer L**2**, which may be referred to as a bottom surface, disposed vertically below the first layer L**1**, as shown in FIGS. **5**-**7**. The first layer L**1**, which may also be referred to as a floor, defines a top of the bottom wall **32***e* and faces the main chamber **14**. The second layer L**2** defines a bottom of the bottom wall **32***c* and faces the drawer chamber **16** (and thus also the drawer **12** received in the drawer chamber **16**). The first layer L**1** of the bottom wall **32***c* is a non-porous member. The second layer L**2** of the bottom wall **32***e* is a porous member having a plurality of pores **32***p* formed therein, as shown in FIGS. **11**, **12**A, and **12**B. Because the bottom wall **32***e* is non-porous by including the non-porous first layer L**1**, liquid and other matter in the main chamber **14** cannot pass into the drawer chamber **16** (or the drawer **12** received in the drawer chamber **16**) through the bottom wall **32***e*. The non-porous first layer L**1** being located vertically above the porous second layer L**2** helps prevent any liquid or other matter in the main chamber **14** from collecting in or passing through the pores **32***p*. In other words, the non-porous first layer L**1** acts as a barrier to the porous second layer L**2**. The layers L**1**, L**2** of the bottom wall **32***c* can be manufactured as a single piece, such that the layers L**1**, L**2** cannot be separated.

Each of the pores **32***p* in this illustrated embodiment has a hexagonal cross-sectional shape. Some of the pores **32***p* along edges of the second layer L**2** may have truncated hexagonal shapes depending on a size and shape of the hexagonal shapes and a size and shape of the bottom wall **32***c*. The bottom wall **32***e* thus includes a plurality of hexagonal ribs that define a hexagonal rib structure in a honeycomb pattern, as shown in FIGS. **11**, **12**A, and **12**B. Each of the pores **32***p* thus define a channel (e.g., groove, depression, cavity) therein and/or between adjacent pores **32***p*. Therefore, an outer surface of each pore **32***p* extends beyond an outer surface of the respective channel. The hexagonal rib structure may increase durability of the bottom layer **32***c* and reduce vertical deflecting of the bottom wall **32***e* downward under a load of the cooling agent and the item(s) in the main chamber **14** without having to increase overall thickness of the bottom wall **32***c* above about 11 mm, thereby reducing overall weight of the insulated container **10** and overall cost of the insulated container **10**. Although the pores **32***p* each have a hexagonal shape in this illustrated embodiment, other cross-sectional shapes may be used, e.g., rectangular, pentagonal, octagonal, etc. The hexagonal shape can have a variety of dimensions. In some variations, each pore can have a length between about 5 mm and about 20 mm, such as about 14 mm. Each pore can have a width between about 0.5 mm and about 2 mm, such as about 1 mm. Each pore can have a height between about 2 mm and about 10 mm.

The thickness of the bottom wall **32***e* described herein (and illustrated in FIG. **12**B as **32***t*) includes the pore depth **32**L**2***t* (which may be referred to as a rib height). The thickness **32***t* can range from about 7 mm to about 11 mm. For example, the overall thickness can range from 7.7 mm to 10.3 mm. In the exemplary embodiment of the bottom wall **32***e* that includes a varying thickness, the pore depth **32**L**2***t* also varies. The pore height **32**L**2***t* can range from about 4 mm to about 8 mm. For example, the first portion of the bottom wall **32***e* having the first thickness includes a first pore depth and the second portion of the bottom wall **32***e* having the second thickness includes a second pore depth. The first pore depth is about 7.3 mm and the second porc depth is about 4.7 mm. The pores **32***p* positioned between the first and second portions can have a gradually decreasing height, such that the pores **32***p* decrease at a constant rate from the first height to the second height. In the exemplary embodiment of the bottom wall **32***e* with a varying thickness, a thickness **32**L**1***t* of the layer L**1** remains constant. In particular, the thickness **32**L**1***t* of the layer L**1** (e.g., a distance between a top surface of the layer L**1**, which is substantially smooth, and the surface of the channels defined by the pores **32***p*) can range from about 2.5 mm to about 3 mm. For example, the thickness **32**L**1***t* of the layer L**1** can be 2.9 mm. Therefore, a first thickness that includes the first pore depth is about 10.3 mm and a second thickness that includes the second pore depth is about 7.7 mm. Accordingly, the first and second thicknesses, and any thickness between, is greater than the distance between the top surface of the layer L**1** and the surface of the channels. Advantageously, the thicknesses being a larger amplitude than the distance facilitates increased structural rigidity of the bottom wall **32***e* while minimizing mass. In particular, the ratio of the thicknesses to the distance described herein facilitates greater resistance to deformation per unit mass than a solid material, such as the solid material that extends along the distance between the top surface of the layer L**1** and the surface of the channels. In other words, a variation where the thickness is equal to, or less than, the distance, as defined herein, would have relatively greater deformation and/or relatively larger mass than the embodiments described herein. Additionally, the change in thickness of the bottom wall **32***c* is attributable to changes in the pore depth. Accordingly, the pore depth described herein can affect the DF value, such as by providing structural rigidity to the bottom wall **32***c* without adding significant mass, which may otherwise make it difficult for a user to maneuver the insulated container and/or negatively impact the heat transfer characteristics between the upper and lower housings **32**, **34**.

Bottom wall deflection testing, under a modelled force of 224 N applied to a bottom wall from within a main chamber (defined by an upper housing formed of polypropylene), has shown that the bottom wall deflects vertically downward less when the bottom wall includes a hexagonal rib structure as a second layer similar to the second layer L**2** of the bottom wall **32***e* than when the bottom wall does not include a hexagonal rib structure. Further examples of deflection testing are provided with reference to FIGS. **27**A-**42**B.

The lower housing **34**, and thus the drawer chamber **16**, has an open front in which the drawer **12** is configured to be received. In some embodiments, the drawer **12** is removably received in the drawer chamber **16** such that the drawer **12** can be removed from the drawer chamber **12**, which may facilitate cleaning of the drawer **12**. In some embodiments, the drawer is non-removably received in the drawer chamber **16**, which may help prevent loss of and/or damage to the drawer **12**.

The drawer chamber **16** defined by the lower housing **34** is a single cavity configured to receive the drawer **12** therein. The drawer **12** is configured to move between a closed configuration, in which the drawer chamber **16** is sealed closed, and an open configuration, in which the drawer chamber **16** is not sealed closed and any item(s) removably contained in the drawer **12** are accessible to a user. The drawer **12** in this illustrated embodiment includes first and second compartments **12***a*, **12***b* that are separate from one another. The drawer **12** having multiple compartments may improve user experience by allowing item(s) in the drawer **12** to be more easily located and/or may help lessen shifting of item(s) in the drawer **12** during transit of the insulated container **10**. In other embodiments, the drawer **12** can have a single compartment or can have more than two compartments.

In an exemplary embodiment, the drawer **12** is formed of polypropylene. In an exemplary embodiment, the drawer **12** is rigid, such as when formed of polypropylene, which may help provide structural integrity to the drawer **12** and to the insulated container **10** with the drawer **12** coupled thereto.

The back wall **34***b* of the lower housing **34** is not a planar member extending vertically in a single plane like each of the left side wall **34**c, the right side wall **34**d, and the bottom wall **34**c of the lower housing **34**. Instead, the back wall **34**b of the lower housing **34** has a U-shaped vertical extension formed therein that defines a second divider wall **38** that extends vertically, as shown in FIGS. **4**, **5**, **13**, and **14**. The second divider wall **38** is centered laterally. The second divider wall **38** is located below and can, as in this illustrated embodiments, be vertically aligned with the first divider wall **36**. The second divider wall **38** being vertically aligned with the first divider wall **36** may help provide durability and strength to the insulated container **10**, for example, by providing load-bearing support to the bottom wall **32**c. In some variations, the second divider wall **38** can extend across a portion of a width of the bottom wall **32**e. For example, the second divider wall **38** can extend up to about 0.25 of the bottom wall width, up to about 0.5 of the bottom wall width, up to about 0.75 of the bottom wall width, the entire width of the bottom wall width, or between about 0.25 and about 0.75 of the bottom wall width. In an exemplary variation, the second divider wall **38** extends across, and thus directly supports, about 0.5 of the bottom wall width. In another exemplary variation, the second divider wall **38** extends across, and thus directly supports, the entire bottom wall width.

The first divider wall **36** extends a complete distance from the back wall **32**b of the upper housing **32** to the front wall **32**a of the upper housing **32**. Conversely, in this illustrated embodiment, the second divider wall **38** extends a partial distance from back to front, as shown in FIGS. **13** and **14**. In an exemplary embodiment, the partial distance is about a half distance from back to front.

The bottom wall deflection testing described above has shown that the second divider wall extending a complete distance from back to front, a so-called "full divider," provides very little additional benefit in terms of deflection. Thus, the second divider wall **38** extending about a half distance from back to front, a so-called "half divider," may provide reduced deflection as compared to no second divider wall being present while allowing for less material to be used in formed the lower housing **34**, and thus allowing for a lower cost of the lower housing **34**.

To account for the presence of the second divider wall **38**, a back wall **12**b of the drawer **12** is not a planar member extending vertically in a single plane like each of the drawer's left side wall **12**c, the right side wall **12**d, and the bottom wall **12**c. Instead, the back wall **12**b of the drawer **12** has a U-shaped vertical extension formed therein having a shape and size corresponding to the second divider wall **38**, as shown in FIGS. **5**, **6**, **13**, and **14**. With the drawer **12** fully slid into the drawer chamber **16**, a back-facing surface of the drawer **12** defined by the back wall **12**b is configured to abut a front-facing surface of the second vertical substantially planar divider wall **38**. FIGS. **13** and **14** show the abutting of these surfaces.

As mentioned above, the upper and lower housings **32**, **34** are configured to be non-removably attached to one another and to be contained within the outer housing **18**. With the upper and lower housings **32**, **34** in the outer housing **18**, a first space **40** is defined between the outer housing **18** and the upper housing **32**, e.g., between an interior surface of the outer housing **18** and an exterior surface of the upper housing **32**, and a second space **42** is defined between outer housing **18** and the lower housing **34**, e.g., between the interior space of the outer housing **18** and an exterior surface of the lower housing **34**. As shown in FIGS. **4**-**6**, the first and second spaces **40**, **42** are continuous with one another since the upper and lower housings **32**, **34** are attached to one another.

The first space **40** is configured to be filled with an insulating material configured to insulate the main chamber **14**, and the second space **42** is configured to be filled with an insulating material configured to insulate the drawer chamber **16** and thus also the drawer **12** received therein. In an exemplary embodiment, the insulating material is the same throughout the insulating container **10**, e.g., polyurethane foam or other insulating material.

The first space **40** extends around the four vertically-extending sides of the upper housing **32** (the front wall **32**a, the back wall **32**b, the left side wall **32**c, and the right side wall **32**d). The lid **20** has a hollow interior **20**h, as shown in FIGS. **6** and **7**, that is configured to be filled with the insulating material. The main chamber **14** is thus configured to be insulated around its perimeter by the insulating material in the first space **40** and along its top by the insulating material in the lid's hollow interior **20**h.

The second space **42** extends around the three vertically-extending sides of the lower housing **34** (the back wall **34**b, the left side wall **34**c, and the right side wall **32**d) and below the bottom wall **34**c of the lower housing **34**. The drawer **12** has a hollow front space **12**h, as shown in FIGS. **6**, **7**, and **13**, that is configured to be filled with the insulating material. The drawer chamber **16**, and therefore the drawer **12** received in the drawer chamber **16**, is thus configured to be insulated along its back and left and right sides by the insulating material in the second space **42** and along its front by the insulating material in the drawer's hollow interior **12**h.

The insulated container **10** includes a drain **44** configured to facilitate draining of liquid (e.g., water from melted ice, spilled beverage, etc.) from the main chamber **14**. As shown in FIG. **4**, the drain **44** is in fluid communication with the main chamber **14**. The drain **44** is configured to be selectively opened and closed by a user, e.g., by removing a plug **46** sealing the drain **44** closed. With the drain **44** closed, liquid in the main chamber cannot exit out of the main chamber **14** through the drain **44** With the drain **44** open, liquid can exit out of the main chamber **14**, and thus out of the insulated container **10**, through the drain **44**. The drain **44** is formed in a left side of the insulated container **10** in this illustrated embodiment, e.g., extends through the left side wall **18**c of the outer housing **18**, but can be located elsewhere. Also, the insulated container **10** includes only one drain **44** in this illustrated embodiment but can include multiple drains. In some embodiments, the drain **44** is omitted.

The insulated container **10** includes a drawer lock **48** configured to lock the drawer **12** in the closed configuration. The drawer lock **48** is configured to move between, e.g., be manually moved by a user between, a locked configuration, in which the drawer **12** is locked in the closed configuration, and an unlocked configuration, in which the drawer **12** is allowed to be moved, e.g., be manually moved by a user, from the closed configuration to the open configuration. The drawer **12** can thus be prevented from opening accidentally, which may help prevent any contents of the drawer **12** from spilling out (e.g., during transit of the insulated container **10**, if the insulated container **10** is dropped accidentally, etc.) and may help prevent the drawer **12** from accidentally being unsealed and thus increasing in temperature. FIGS. **1**, **2**, **6**, and **8** show the drawer lock **48** in the unlocked configuration.

The drawer **12** can, as in this illustrated embodiment include a handle **12***n* configured to be handheld by a user to facilitate opening and closing of the drawer **12**. The handle **12***n* in this illustrated embodiment includes a ring pivotally coupled at a top thereof to the outer housing **18**. Under the force of gravity the handle **12***n* is urged to be seated in a first depression **50** formed in a front exterior surface of the drawer **12**. The handle **12***n* being seated in the first depression **50** can help keep the handle **12***n* out of the way when not in use. The handle **12***n* can have configurations other than a ring, such as a depression formed in the front exterior surface of the drawer **12** and defining a hand or finger hold therein, a knob, etc.

The drawer lock **48** is configured to move vertically between the unlocked and locked configurations. The drawer lock **48** in the unlocked configuration is located vertically above the drawer lock in the locked configuration. In the locked configuration, the drawer lock **48** is seated at least partially in a second depression **52** formed in the front exterior surface of the drawer **12**. In the unlocked configuration, the drawer lock **48** is not seated in the second depression **52**.

FIGS. **16-19** illustrate another embodiment of an insulated container **100** that includes a drawer **102**. The insulated container **100** in this illustrated embodiment is generally configured and used similar to the insulated container **10** of FIGS. **1-15**, e.g., includes a drawer **102** having two compartments, a drawer handle **102***n*, a main chamber **104**, a drawer chamber (obscured in the figures), an outer housing **108**, a lid **120**, lock holes **120***h* of the lid **120**, locks holes **108***h* of the outer housing **108**, a lid lock **121**, opposed side handles **124**, a front handle **130**, an upper housing **132**, a lower housing (obscured in the figures), a vertically-extending divider wall (obscured in the figures) of the lower housing, insulating material (obscured in the figures), a drain **144**, and a vertically-movable drawer lock **148**.

FIGS. **16-18** show each of the lid **120** and the drawer **102** closed, and FIG. **19** shows each of the lid **120** and the drawer **102** open. FIGS. **16-18** each show the lid lock **121** in the locked configuration, and FIG. **19** shows the lid lock **121** in the unlocked configuration. FIGS. **16-18** each show the drawer lock **148** in the locked configuration, and FIG. **19** shows the drawer lock **148** in the unlocked configuration. The drawer lock **148** in this illustrated embodiment includes an indicator **148***i* configured to indicate whether the drawer lock **148** is locked. The indicator **148***i* can have a variety of configurations, e.g., a color, text, a symbol, a light, etc. In this illustrated embodiment, the indicator **148***i* includes an area of the outer housing **108** in a first color that is configured to be visible with the drawer lock **148** in the locked configuration and that is configured to not be visible with the drawer lock **148** in the unlocked configuration. The first color is a different color than a color of the outer housing **108** at least in an area immediately surrounding the first color. The indicator **148***i* is therefore visible in FIGS. **16-18** and is not visible in FIG. **19**.

The drawer handle **102***n* in this illustrated embodiment includes a depression formed in the front exterior surface of the drawer **102** and defining a hand or finger hold therein.

In this illustrated embodiment, the insulated container **100** does not include a vertically-extending divider wall in the main chamber **104**. However, the main chamber **104** has a slot **104***s* formed therein in which a vertically-extending divider wall similar to the first divider wall **36** can be selectively received.

FIGS. **20** and **21** illustrate another embodiment of an insulated container **200** that includes a drawer **202**. The insulated container **200** in this illustrated embodiment is generally configured and used similar to the insulated container **10** of FIGS. **1-15**, e.g., includes a drawer **202** having two compartments, a drawer handle **202***n*, a main chamber **204**, a drawer chamber (obscured in the figures), an outer housing **208**, a lid **220**, a lid lock **221**, opposed side handles **224**, a front handle **230**, an upper housing **232**, a lower housing (obscured in the figures), a vertically-extending divider wall (obscured in the figures) of the lower housing, a drawer lock, and insulating material (obscured in the figures).

FIG. **20** shows each of the lid **220** and the drawer **202** closed, and FIG. **21** shows each of the lid **220** and the drawer **202** open. FIGS. **20** and **22** show the drawer lock in the locked configuration, and FIGS. **21** and **23** show the drawer lock in the unlocked configuration. The drawer lock in this illustrated embodiment includes a protrusion **248***a* extending from the drawer handle **202***n* and a first depression **248***b* formed in the outer housing **208**. As shown in FIGS. **22** and **23**, the drawer handle **202***n* is pivotally attached to the outer housing **208**. The drawer handle **202***n* is configured to rotate in a first direction, e.g., counterclockwise as shown by an arrow A**1** in FIG. **22**, to move the drawer lock from the unlocked configuration to the locked configuration. With the drawer lock in the locked configuration, the protrusion **248***a* is seated in the first depression **248***b* and the drawer handle **202***n* is seated in a second depression **250** formed in a front exterior surface of the drawer **202**. The protrusion **248***a* being seated in the first depression **248***b* prevents the drawer **202** from sliding or being pulled out of the outer housing **208**. The drawer handle **202***n* is configured to rotate in a second, opposite direction, e.g., clockwise as shown by an arrow A**2** in FIG. **23**, to move the drawer lock from the locked configuration to the unlocked configuration. With the drawer lock in the unlocked configuration, the protrusion **248***a* is not seated in the first depression **248***b* and the drawer handle **202***n* is not seated in the second depression **250**. The drawer **202** is thus free to slide or be pulled out of the outer housing **208**.

FIGS. **20** and **24** shows the lid lock **221** in the locked configuration, and FIGS. **21** and **25** show the lid lock **221** in the unlocked configuration. The lid lock **221** in this illustrated embodiment is configured to be selectively seated in a third depression **220***d* formed in the lid **220**. As shown in FIGS. **24** and **25**, the lid lock **221** is pivotally attached to the front handle **230**, and the front handle **230** is pivotally attached to the outer housing **208**. The front handle **230** is configured to rotate in a first direction, e.g., counterclockwise as shown by an arrow A**3** in FIG. **24**, to move the lid lock **221** from the unlocked configuration to the locked configuration. With the lid lock **221** in the locked configuration, a lip **221***p* of the lid lock **221** is seated in the third depression **220***d*. The lip **221***p* being seated in the third depression **220***d* prevents the lid **220** from opening. The front handle **230** is configured to rotate in a second, opposite direction, e.g., clockwise as shown by an arrow A**4** in FIG. **25**, to move the lid lock **221** from the locked configuration to the unlocked configuration. With the lid lock **221** in the unlocked configuration, the lip **221***p* is not seated in the third depression **220***d*. The lid **220** is thus free to be opened.

In this illustrated embodiment, the insulated container **200** does not include a vertically-extending divider wall in the main chamber **204**. However, the main chamber **204** can have a slot therein similar to the slot **104***s* of FIG. **19**.

A cooling agent **201** in the form of ice is shown in the main chamber **204** of the insulated container **200**, although another type of cooling agent can be used instead of or in addition to icc. FIG. **21** also illustrates examples of one or more first items **203** contained in the main chamber **204** as metal beverage cans and examples of one or more second items **205** contained in the drawer **202** as metal beverage cans and plastic containers holding food.

FIG. **26** illustrates another embodiment of an insulated container **300** that includes a drawer **302**. The insulated container **300** in this illustrated embodiment is generally configured and used similar to the insulated container **10** of FIGS. **1-15**, e.g., includes a drawer **302**, a main chamber (obscured in FIG. **26**), a drawer chamber (obscured in FIG. **26**), an outer housing **308**, a lid **320**, a lid lock **321**, opposed side handles **324** (one of the handles **324** is obscured in FIG. **26**), a front handle **330**, an upper housing (obscured in FIG. **26**), a lower housing (obscured in FIG. **26**), a vertically-extending divider wall (obscured in FIG. **26**) of the lower housing, a vertically-extending divider wall (obscured in FIG. **26**) of the upper housing, and insulating material (obscured in FIG. **26**). FIG. **26** shows each of the lid **320** and the drawer **302** closed.

The drawer **302** in this illustrated embodiment includes first and second drawers that are configured to be opened and closed independent of one another. The drawer **302** thus defines two compartments but in two separate drawers instead of in a single drawer like the drawers **12**, **102**, **202** discussed above. Each of the two drawers includes its own handle **302***n*. The insulated container **300** includes a plurality of drawers instead of a single drawer may help maintain coolness in a closed one of the drawers with the other of the drawers being open. A single drawer like the drawers **12**, **102**, **202** discussed above may be easier and/or more cost effective to manufacture, such as using injection molding as discussed further below. Each of the drawers of FIG. **26** can be formed using injection molding but as separate elements instead of a single element like the drawers **12**, **102**, **202** discussed above.

The lid lock **321** in this illustrated embodiment includes first and second lid locks instead of a single lid lock like the lid locks **21**, **121**, **221** discussed above. Having more than one lid lock provides redundancy in case of lid lock failure. However, having more than one lid lock requires more user action than a single lid lock since more than one lid lock must be unlocked before the lid can be opened.

The handles **324** in this illustrated embodiment each include a pivotal handhold **325**, similar to the strap, rope, or other member discussed above, engaged with at least one opening of each handle **324**, similar to the openings **26** of FIG. **15** discussed above.

The front handle **330** in this illustrated embodiment includes a depression formed in the front exterior surface of the drawer outer housing **308** and defining a hand or finger hold therein.

An insulated container as described herein, e.g., the insulated container **10** of FIGS. **1-5**, the insulated container **100** of FIGS. **16-19**, the insulated container **200** of FIGS. **20** and **21**, and the insulated container **300** of FIG. **26**, can be manufactured in any of a variety of ways. In an exemplary embodiment, an insulating container as described herein is formed using injection molding.

Using injection molding to manufacture the insulated container may allow for finer details and tolerance control than other manufacturing methods, such as rotomolding (also referred to as rotational molding). For example, a bottom surface of an upper housing including a hexagonal rib structure as discussed above is possible to form using injection molding but would not be possible to form with as much fine detail and as much tolerance control using other manufacturing methods, such as rotomolding. Having a detailed hexagonal rib structure that allows for a very small manufacturing tolerance may help ensure that the hexagonal rib structure provides the durability and thermal effects discussed herein. For another example, a vertically-extending divider wall of a lower housing and a drawer having a corresponding shape configured to abut the lower housing's vertically-extending divider wall is possible to form using injection molding but would not be possible to form with as much fine detail and as much tolerance control using other manufacturing methods, such as rotomolding. Having a detailed vertically-extending divider wall of a lower housing and a drawer having a corresponding shape that allows for a very small manufacturing tolerance may help ensure that the drawer abuts the vertically-extending divider wall so as to minimize any thermal loss from within the drawer. For yet another example, guidance rail features of a drawer are configured to aid in opening and closing the drawer, as will be appreciated by a person skilled in the art. The drawer's guidance rail features, e.g., guidance rail features **12***g* on a side of the drawer as in the illustrated embodiment of FIG. **5**, are configured to slide in corresponding guidance rail features of an outer housing, e.g., guidance rail features **18***g* of the outer housing **18** as shown in FIG. **5**. Forming the drawer's and the lower housing's guidance rail features with the detail and tolerance control of injection molding may help ensure secure mating of the guidance rail features so as to minimize any thermal loss from within the drawer and/or may help smooth sliding of the drawer in and out of the lower housing's drawer chamber. For another example, forming a lid and an outer housing with injection molding may help ensure that a lid lock securely locks the lid in a closed configuration to maintain a complete seal of a main chamber within the outer housing (e.g., within an upper housing disposed within the outer housing) because of the fine detail and manufacturing control allowed by injection molding. For still another example, forming a drawer and an outer housing with injection molding may help ensure that a drawer lock securely locks the drawer in a closed configuration to maintain a complete seal of the drawer because of the fine detail and manufacturing control allowed by injection molding. For yet another example, forming an outer housing with injection molding may allow for a channel to be formed in the outer housing that is configured to seat therein a sealing gasket configured to help seal a closed drawer. The channel is also configured for detents to be mounted therein configured to engage corresponding indentations of a closed drawer and thereby help keep the drawer closed. The fine detail and tolerance control allowed by injection molding may help ensure that the sealing gasket seats securely therein to form as complete a seal as possible and may help ensure that the detents are of proper size and shape to engage the drawer. FIGS. **7** and **7**A illustrate one embodiment of a scaling gasket **33**, detents **35**, and indentations **37**.

Using injection molding to manufacture the insulated container may allow for individual components of the insulated container to be formed separately. Forming components separately may improve overall structural integrity of each individual component and thus overall structural integrity of the fully assembled insulated container. Forming components separately may improve cooling performance since a singular member does not have seams, joints, or other connection areas that would exist if the singular member was instead formed of two or more parts connected together. For example, forming an upper housing as a singular member may improve cooling performance since there are not seams, joints, or other connection areas in the upper housing through which coolness provided by a cooling agent in the main chamber can escape. For example, forming a drawer as a singular member may improve cooling performance since there are not seams, joints, or other connection areas in the drawer through which coolness in the drawer chamber can escape. Forming components separately may help prevent leaks since a singular member does not have seams, joints, or other connection areas where leaks are most likely to develop. For example, forming an upper housing as a singular member may help prevent melted ice from leaking out of the main chamber. For another example, forming a drawer as a singular member may help prevent liquid spilled out of a bottle in a first compartment of the drawer from leaking into a second compartment of the drawer or out of the drawer at all.

In general, an injection molding process includes injecting a molten material into a mold and then allowing the material to cool and harden in the mold. Injection molding is a relatively high pressure process since a compressive force is applied to the mold during the cooling and hardening process to help keep the mold closed. Also, the mold is still during the cooling and hardening process.

In general, a rotomolding process includes filling a mold with a material and heating the filled mold (e.g., in an oven) while the filled mold rotates. The filled mold is then removed from heat and allowed to cool so the material in the mold cools and hardens in the mold. Rotomolding is a relatively low pressure process since a compressive force is not applied to the mold during the rotating or cooling stages of rotomolding.

As discussed above, an insulated container can include an upper housing, a lower housing, an outer housing, a lid, and a drawer. In an exemplary embodiment, each of the upper housing, the lower housing, the outer housing, the lid, and the drawer are formed with injection molding. The material of the upper housing, the lower housing, the outer housing, the lid, and the drawer is polypropylene in an exemplary embodiment, although other materials are possible. Polypropylene has a high enough flow rate to be used in injection molding while also providing the rigidity needed for structural integrity of the insulated cooler. In some embodiments, a ultraviolet (UV) resistant material can be used to form at least the outer housing and/or can be used as a coating on the outer housing, which may help improve insulating properties of the insulated container.

Each of the upper housing, the lower housing, the outer housing, the lid, and the drawer is separately formed with injection molding so as to each be a singular member. After being formed, the upper housing, the lower housing, the outer housing, the lid, and the drawer are assembled along with other components of the insulated container, e.g., vertically-extending divider wall in the main chamber of the upper housing, insulating material, etc. The upper housing, the lower housing, the outer housing, the lid, and the drawer can be made in any order, and assembly of one or more of the upper housing, the lower housing, the outer housing, the lid, and the drawer may begin before one or more other components of the insulated container have been made.

In an exemplary embodiment, assembly of the insulated container includes fixedly securing the upper and lower housings together such that a bottom wall of the upper housing defines a top wall of a drawer chamber defined by the lower housing and such that the bottom wall separates the drawer chamber from a main chamber defined by the upper housing. As discussed above, with the upper and lower housings disposed in the outer housing, space is defined between the outer housing and the upper and lower housings. The assembly of the insulated container also includes filling the space with an insulating material. The insulating material is polyurethane foam in an exemplary embodiment, but other materials are possible. Further, in an exemplary embodiment, the same insulating material is used throughout the insulated container, but in some embodiments, an insulated container can include two or more different insulating materials.

Assembly of the insulated container also including coupling the drawer to the lower housing, e.g., disposed in the drawer in the drawer chamber. In an exemplary embodiment, the drawer is coupled to the lower housing after the lower housing has been fixedly secured to the upper housing and disposed in the outer housing and after insulating material has filled space defined between the outer housing and the upper and lower housings. A front space of the drawer is also filled with insulating material, as discussed above, which, in an exemplary embodiment, occurs prior to the drawer being coupled to the lower housing.

Assembly of the insulated container also including coupling the lid to the upper housing. In an exemplary embodiment, the lid is coupled to the upper housing after the upper housing has been fixedly secured to the lower housing and disposed in the outer housing and after insulating material has filled space defined between the outer housing and the upper and lower housings. The lid is also filled with insulating material, as discussed above, which, in an exemplary embodiment, occurs prior to the lid being coupled to the upper housing.

For insulated containers that include a removable vertically-extending divider wall in the main chamber, assembly of the insulated container also including disposing the vertically-extending divider wall in the main chamber. In an exemplary embodiment, the vertically-extending divider wall is disposed in the main chamber after the upper housing has been fixedly secured to the lower housing and disposed in the outer housing and after insulating material has filled space defined between the outer housing and the upper and lower housings.

EXAMPLES

The insulated containers described herein can be configured to contain one or more objects. For example, one or more objects, such as food, drinks, and/or containers thereof, can be contained in a main chamber of an insulated container and/or one or more objects can be contained in a drawer chamber of the insulated container. Furthermore, the insulated containers can experience one or more of a static load and a dynamic load (e.g., drops) during use. The one or more dynamic loads can occur when the one or more objects are contained within the insulated container. The insulated container described herein, such as but not limited to the insulated container **10** of FIG. **1**, insulated container **100** of FIG. **16**, insulated container **200** of FIG. **20**, or the insulated container **300** of FIG. **26**, can withstand the one or more static loads and dynamic loads without failing. In particular, the insulated containers can plastically deform without elongating to failure. The examples described herein provide data associated with structural testing of at least a portion of an insulated container in accordance with the descriptions provided herein. The examples provided should not be construed as limiting the insulated container in any way and are only intended to provide data associated with illustrative embodiments.

Example 1

An exemplary embodiment of an insulated container in accordance with the description provided was analyzed for static and dynamic conditions when loaded with one or more objects. The analysis was performed using a finite element analysis technique based on a finite element mesh. For example, as shown in FIGS. **27**A-**27**C, an upper housing **1000** of an insulated container were analyzed when loaded with a plurality of cans **1004**. The plurality of cans **1004** were positioned within a main chamber **1002** of the upper housing **1000**. The description of the upper housing **1000** is similar to the description provided with reference to the upper housing **32** shown in FIGS. **4**-**6**, the upper housing **232** shown in FIGS. **20**-**21**, or any other upper housing described herein. The plurality of cans **1004** were positioned on a top surface of a bottom wall **1006** of the upper housing **1000**. The description of the bottom wall **1006** is similar to the description provided with reference to the bottom wall **32***e*, or any other bottom wall described herein. The plurality of cans **1004** was assumed to apply a force of about 224 N to the top surface of the bottom wall **1006**. As shown in FIG. **27**B, a bottom surface of the bottom wall **1006** is substantially smooth. In contrast, an upper housing **1000***a* was also included in the analysis and, as shown in FIG. **27**C, a bottom surface of a bottom wall **1006***a* thereof includes a plurality of hexagonal ribs **1012**. The insulated containers **1000**, **1000***a* and respective bottom walls **1006**, **1006***a* are substantially identical aside from the inclusion of the plurality of hexagonal ribs **1012** in the bottom wall **1006***a*.

The analysis assumed portions of the upper housings **1000**, **1000***a* were supported. In particular, three configurations of support are shown in FIGS. **28**A-**28**C. In a first configuration shown in FIG. **28**A, a perimeter support **1020** extends around a perimeter of the bottom wall **1006**, such that the perimeter of the bottom wall **1006** would not move or otherwise deflect. The perimeter support **1020** could be a drawer chamber (not shown) of a lower housing (not shown). In a second configuration shown in FIG. **28**B, the bottom wall **1006** was supported by the perimeter support **1020** in addition to a first central support **1022** that extended along about half of a width of the bottom wall **1006**. In a third configuration shown in FIG. **28**C, the bottom wall **1006** was supported by the perimeter support **1020** in addition to a second central support **1024** that extended along the entire width of the bottom wall **1006**. The first central support **1022** or the second central support **1024** could be positioned within a lower housing (not shown). While not shown, the bottom wall **1006***a* was supported in an identical manner for purposes of the analysis.

Results of a static load analysis are shown in FIGS. **29**A-**30**C. In the static load analysis, the upper housings **1000**, **1000***a* in each of the three support configurations were analyzed for deflection and stresses of the bottom walls **1006**, **1006***a* due to the plurality of cans **1020** while in a static condition (e.g., not moving). The results shown in FIGS. **29**A-**29**C correspond to the upper housing **1000** with the bottom wall **1006**. Furthermore, FIG. **29**A corresponds to the third support configuration of FIG. **28**C, FIG. **29**B corresponds to the second support configuration of FIG. **28**B, and FIG. **29**C corresponds to the first support configuration of FIG. **28**A. As shown, the third support configuration corresponded to a maximum deflection of 4.677 mm, the second support configuration corresponded to a maximum deflection of 4.679 mm, and the first support configuration corresponded to a maximum deflection of 5.264 mm. The bottom wall **1006** had a thickness of about 7.6 mm. Therefore, a deformation factor (DF) using Equation 1 can be calculated. The DF for the configuration of FIG. **29**A is about 0.62, the DF for the configuration of FIG. **29**B is about 0.62, and the DF for the configuration of FIG. **29**C is about 0.69.

In contrast, the results shown in FIGS. **30**A-**30**C correspond to the upper housing **1000***a* with the bottom wall **1006***a*. FIG. **30**A corresponds to the third support configuration of FIG. **28**C, FIG. **30**B corresponds to the second support configuration of FIG. **28**B, and FIG. **30**C corresponds to the first support configuration of FIG. **28**A. As shown, the third support configuration corresponded to a maximum deflection of 0.633 mm, the second support configuration corresponded to a maximum deflection of 0.641 mm, and the first support configuration corresponded to a maximum deflection of 1.026 mm. Similar to the bottom wall **1006**, the bottom wall **1006***a* had a thickness of about 7.6 mm and a DF can be calculated using Equation 1. The DF for the configuration of FIG. **30**A is about 0.083, the DF for the configuration of FIG. **30**B is about 0.084, and the DF for the configuration of FIG. **30**C is about 0.14. The results show that the bottom wall **1006***a* deflected significantly less than the bottom wall **1006** under the same load conditions. Therefore, the inclusion of the plurality of ribs **1012** in the bottom wall **1006***a* of the upper housing **1000***a* effectively and significantly increased the structural rigidity of the bottom wall **1006***a*.

Additionally, a dimension of the plurality of ribs **1020** was analyzed. In particular, a rib height of each rib of the plurality of ribs **1020** was altered to determine any effects thereof. Using the second support configuration corresponding to FIG. **28**B, results for the bottom wall **1006** having a smooth surface are shown in FIG. **31**A, a bottom wall having a first rib height of about 5.75 mm (for a thickness of about 8.75 mm) are shown in FIG. **31**B, and a bottom wall having a second rib height of about 9.0 mm (for a thickness of about 11 mm) are shown in FIG. **31**C. The variation having the first rib height had a measured maximum deflection of about 1.394 mm, for a DF of about 0.18, and the variation having the second rib height had a measured maximum deflection of about 0.641 mm, for a DF of about 0.058. The results show that the maximum deflection of the bottom wall decreases as the rib height increases.

Results from a dynamic load analysis are shown in FIGS. **32**A-**33**C. In particular, plastic strain analysis was performed assuming the upper housings **1000**, **1000***a* were dropped from a predetermined height while containing the plurality of cans **1020**. In this analysis, the predetermined height was about 1.3716 m (54 inches). FIGS. **32**A-**32**C correspond to the upper housing **1000** and FIGS. **33**A-**33**C correspond to the upper housing **1000***a*. Similar to the static analyses, the first, second, and third support configurations were analyzed for each upper housing **1000**, **1000***a*. In particular, FIG. **32**A corresponds to the third support configuration of FIG. **28**C, FIG. **32**B corresponds to the second support configuration of FIG. **28**B, and FIG. **32**C corresponds to the first support configuration of FIG. **28**A. The maximum strain shown in FIG. **32**A is 19%, the maximum strain shown in FIG. **32**B is 59.9%, and the maximum strain shown in FIG. **32**C is 24.9%. Regarding the upper housing **1000***a* with the plurality of ribs **1012**, FIG. **33**A corresponds to the third support configuration of FIG. **28**C, FIG. **33**B corresponds to the second support configuration of FIG. **28**B, and FIG. **33**C corresponds to the first support configuration of FIG. **28**A. The maximum strain shown in FIG. **33**A is 24%, the maximum strain shown in FIG. **33**B is 24%, and the maximum strain shown in FIG. **33**C is 53.8%. The results show that the maximum strain generally decreases as more support is provided to the bottom wall. Additionally, the results indicate that the maximum strain is generally lower with the inclusion of the hexagonal ribs.

Example 2

Another exemplary embodiment of an insulated container in accordance with the description provided was analyzed for static and dynamic conditions when loaded with one or more objects. The analysis was performed using a finite element analysis technique based on a finite element mesh. For example, as shown in FIGS. **34**A-**34**C, an upper housing **1100** of an insulated container was analyzed when loaded with a plurality of cans (not shown) or a fluid (not shown). Similar to the upper housing **1000** described with reference to FIGS. **27**A-**33**C, the upper housing **1100** has a main chamber **1102** and a bottom wall **1106**. The analysis was performed assuming the entire force of the plurality of cans was spread across the bottom wall **1106**. In particular, each can of the plurality of cans was assumed to have a mass of about 357 g and the plurality of cans included 64 cans. Therefore, the plurality of cans was assumed to apply a force of about 224 N to the top surface of the bottom wall **1106**, which is equivalent to about 1.51 kPa.

The analysis assumed portions of the upper housing **1100** was supported. In particular, as shown in FIG. **34**B, a perimeter support **1124** extends around at least a portion of a perimeter of the bottom wall **1106**, such that the perimeter of the bottom wall **1106** would not move or otherwise deflect. The bottom wall **1106** was further supported by a central support **1126** that extended along about half of a width of the bottom wall **1106**. The central support **1126** was positioned at a midpoint of a length of the bottom wall **1106**, such that the bottom wall was evenly supported by the central support **1126**. Additionally, as shown in FIG. **34**C, an upper edge support **1122** supported an upper edge **1120** of the upper housing **1100**.

Results of a static load analysis are shown in FIGS. **35**A-**35**B. In FIG. **35**A, the plurality of cans was assumed to be evenly distributed across the bottom wall **1106**. The resulting plot shows that the maximum von Mises stress was about 5.162 MPa, which is significantly below the 22 MPa yield stress of polypropylene. In FIG. **35**B, the main chamber **1102** was completely filled with water. The resulting plot shows that the maximum von Mises stress was about 7.346 MPa, which is significantly below the 22 MPa yield stress of polypropylene. In both cases, the maximum von Mises stress corresponds to a safety factor of about 3 for such stationary loading conditions.

Results of a first dynamic load analysis are shown in FIGS. **36**A-**36**C. Under the same support conditions described with reference to FIGS. **34**B-**34**C, plastic strain analysis was performed assuming the upper housing **1100** was dropped from a first predetermined height while containing the plurality of cans. In this analysis, the predetermined height was about 0.762 m (30 inches). The peak equivalent plastic strain was about 10% and was concentrated along the perimeter support **1124** and central support **1126**.

Results of a second dynamic load analysis are shown in FIGS. **37**A-**37**C. Under the same support conditions described with reference to FIGS. **34**B-**34**C, plastic strain analysis was performed assuming the upper housing **1100** was dropped from a second predetermined height while containing the plurality of cans. In this analysis, the predetermined height was about 1.3716 m (54 inches). The peak equivalent plastic strain was about 10% and was concentrated along the perimeter support **1124** and central support **1126**.

Example 3

Still another exemplary embodiment of an insulated container in accordance with the description provided was analyzed for dynamic conditions when loaded with one or more objects. The analysis was performed using a finite element analysis technique based on a finite element mesh. For example, as shown in FIGS. **38**A-**38**B, the analysis included an upper housing **1200** and a lower housing **1202**. The description of the upper housing **1000** is similar to the description provided with reference to the upper housing **32**, including the bottom wall **32***c*, shown in FIGS. **4**-**6**, the upper housing **232** shown in FIGS. **20**-**21**, or any other upper housing described herein. Similarly, the lower housing **1202** is similar to the description provided with reference to the lower housing **32** shown in FIGS. **4**-**6** or any other lower housing described herein. The analysis assumed that the lower housing **1202** was empty whereas the upper housing **1200** contained a plurality of cans **1230**. The plurality of cans **1230** were positioned within a main chamber **1212** of the upper housing **1200**. The plurality of cans **1230** were positioned on a top surface of a bottom wall **1206** of the upper housing **1200**. The plurality of cans **1230** was assumed to apply a force of about 224 N to the top surface of the bottom wall **1206**. The top surface of the bottom **1206** was substantially smooth whereas a bottom surface of the bottom wall **1206** included a plurality of ribs **1207**, as shown in FIGS. **40**A and **42**A.

The analysis assumed portions of the upper housing **1200** and lower housing **1202** were supported. In particular, the upper housing **1200** and lower housing **1202** were not fixed together, but each was assumed to be fixed relative to an outer housing (not shown) of an insulated container. An upper edge **1220** of the upper housing **1200** was fixed along an upper edge support **1222** and the lower housing **1202** was fixed along a bottom support **1226** of a bottom surface of the lower housing **1202**.

Results of a dynamic load analysis are shown in FIGS. **39** and **40**A-**40**C. In a first dynamic load analysis, analysis was performed assuming the upper and lower housings **1200**, **1202** were dropped from a first predetermined height while the upper housing **1200** contained the plurality of cans **1230**. In this analysis, the first predetermined height was about 1.3716 m (54 inches). The maximum deformation of the bottom wall **1206**, as shown in FIG. **39**, was about 31.389 mm, for a DF of about 4.13. The maximum plastic strain, as shown in FIGS. **40**A-**40**C, was about 186%. Plastic strains were developed in locations of the upper housing **1200** where stress reached or exceeded the material yield strength of the material. However, the plastic strains do not exceed the tensile elongation at failure, which is about 200% for polypropylene. Accordingly, the upper housing **1200** has sufficient structural integrity to withstand the forces (e.g., avoid failure) associated with the plurality of **1230** and the first predetermined height.

In a second dynamic load analysis, analysis was performed assuming the upper and lower housings **1200**, **1202** were dropped from a second predetermined height while the upper housing **1200** contained the plurality of cans **1230**. In this analysis, the second predetermined height was about 0.762 m (30 inches). The maximum deformation of the bottom wall **1206**, as shown in FIG. **41**, was about 22.933 mm, for a DF of about 3.02. The maximum plastic strain, as shown in FIGS. **42**A-**42**B, was about 125%. Plastic strains were developed in locations of the upper housing **1200** where stress reached or exceeded the material yield strength of the material. However, similar to the results of FIGS. **40**A-**40**C, the plastic strains do not exceed the tensile elongation at failure, which is about 200% for polypropylene. Accordingly, the upper housing **1200** has sufficient structural integrity to withstand the forces (e.g., avoid failure) associated with the plurality of **1230** and the second predetermined height.

One skilled in the art will appreciate further features and advantages of the devices, systems, and methods based on the above-described embodiments. Accordingly, this disclosure is not to be limited by what has been particularly shown and described, except as indicated by the appended claims. All publications and references cited herein are expressly incorporated herein by reference in their entirety for all purposes.

The present disclosure has been described above by way of example only within the context of the overall disclosure provided herein. It will be appreciated that modifications within the spirit and scope of the claims may be made without departing from the overall scope of the present disclosure.

What is claimed is:

1. An insulated container, comprising:

a housing having a polypropylene horizontal divider wall, the divider wall having a non-porous upper layer and a porous lower layer, wherein the porous lower layer has at least two pores each having a hexagonal cross-sectional shape, and wherein a thickness of the non-porous upper layer is constant, a thickness of the porous lower layer varies along a length thereof, and the thickness of the porous lower layer is greater than the thickness of the non-porous upper layer.

2. The insulated container of claim **1**, wherein

the non-porous surface is substantially smooth; and

a plurality of ribs define the at least two pores there between, the ribs being arranged in a honeycomb pattern configured to inhibit vertical deformation of the horizontal divider wall.

3. The insulated container of claim **2**, wherein at least one rib of the plurality of ribs is truncated.

4. The insulated container of claim **1**, wherein the porous lower layer is parallel to a bottom wall of the housing.

5. The insulated container of claim **1**, wherein the non-porous upper layer is sloped relative a bottom wall of the housing and is configured to direct a liquid towards a drain of the housing.

6. The insulated container of claim **1**, wherein the thickness of the non-porous upper layer is between about 2.5 mm and 3 mm.

7. The insulated container of claim **1**, wherein the thickness of the porous lower layer ranges from about 4 mm to about 8 mm.

8. The insulated container of claim **1**, wherein the non-porous upper layer defines a bottom of an upper housing of the insulated container and the porous lower layer defines a top of a lower housing of the insulated container.

9. The insulated container of claim **1**, wherein the horizontal divider wall has a width and a length, the length being greater than the width.

10. The insulated container of claim **1**, wherein the at least two pores are configured to inhibit deformation of the horizontal divider wall.

11. The insulated container of claim **1**, wherein a depth of each of the at least two pores varies.

12. The insulated container of claim **2**, wherein each rib of the plurality of ribs has a hexagonal cross-sectional shape.

13. The insulated container of claim **2**, wherein the non-porous upper layer defines a bottom of an upper housing of the insulated container and the porous lower layer defines a top of a lower housing of the insulated container; and

the horizontal divider wall has a first vertical distance as measured between the top and the bottom within the at least two pores and a second vertical distance as measured between the top and the bottom surface at the ribs.

14. The insulated container of claim **13**, wherein the second vertical distance varies along a length of the horizontal divider wall.

15. The insulated container of claim **14**, wherein the first vertical distance remains constant along a length of the horizontal divider wall.

16. The insulated container of claim **13**, wherein the second vertical distance is between about 7 mm and about 11 mm.

17. The insulated container of claim **13**, wherein the first vertical distance is between about 2.5 mm and 3 mm.

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